

JPRS 77890

21 April 1981

USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

No. 81



FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service (NTIS), Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semimonthly by the NTIS, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

Soviet books and journal articles displaying a copyright notice are reproduced and sold by NTIS with permission of the copyright agency of the Soviet Union. Permission for further reproduction must be obtained from copyright owner.

21 April 1981

**USSR REPORT
ELECTRONICS AND ELECTRICAL ENGINEERING
No. 81**

CONTENTS

ANTENNAS

Synthesis of a Weakly Directional Antenna With High Electromagnetic Compatibility.....	1
Input Impedance of a Vibrator Parallel to the Edge of a Wedge.....	2
The Directional Patterns of Antennas When Operating With Very Short Pulses.....	2
A Study of the Possibility of Reducing Background Radiation From the Reflecting Antenna of a Weather Radar.....	3
Effect of Space-Time Light Modulator and Noise on Characteristics of Radiooptical Antenna Arrays.....	3
The Problem of the Diffraction Synthesis of Antennas With a Supplemental Condition Placed on the Level of the Field in the Shadow Zone.....	4

**CERTAIN ASPECTS OF COMPUTER HEAD AND SOFT WARE:
CONTROL, AUTOMATION, TELEMECHANICS, TELEMETERING,
MACHINE DESIGNING AND PLANNING**

Ferroacoustic Data Storage Devices.....	5
---	---

CERTAIN ASPECTS OF PHOTOGRAPHY, MOTION PICTURES AND TELEVISION

Noise Conversion in Transmitting Television Tubes.....	6
Special Features of Construction of Stereo Television Transmitting Cameras.....	6

Semiconductor Integrated Microcircuit for Scanning Line Generators of Television Receivers.....	7
Analysis of the Process of Recording in Video Recorders.....	7
Measurement of the Frequency-Contrast Characteristic of TV Camera Lenses.....	8
CERTAIN ASPECTS OF RADIOASTRONOMY, SATELLITES AND SPACE VEHICLES	
Theory of Uniaxial Offset Guidance of Astronomic Telescopes.....	9
CIRCUIT THEORY AND PRACTICE	
Phase Modulation and Complex Squid Circuits.....	10
Electromagnetic Field in Magnetic Circuits in the Case of Their Magnetization by a Given Current.....	10
COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS AND TRANSMITTERS, NETWORKS, RADIO PHYSICS, DATA TRANSMISSION AND PROCESSING, INFORMATION THEORY	
Interpretation of Polarization Characteristics of Optical Signals in Lidar Detection of Dispersed Media.....	11
The Quantum Filtering of Markov Signals Against a Background of White Quantum Noise.....	11
The Influence of Daily Variations in Environmental Parameters on the Statistics of Angles of Refraction.....	12
On the Problem of Evaluating the Average Power of Signals in m-Fading.....	13
Methods of Measuring the Attenuation in Optical Cables (Survey).....	13
Optimization of Losses in Splices Along Optical-Cable Lines.....	14
Foreign Experience in Laying and Installation of Optical Cables (Survey).....	15
External Field and Interference Immunity of Twisted Optical Fibers.....	15

Law of Distribution of Fluctuations in the Intensity of Optical Emission Propagating in a Turbulent Atmosphere.....	16
Optoelectronic Devices for Optical-Cable Communication Systems.....	17
Additional Losses in an Optical Cable.....	17
An Instrument for Measuring the Attenuation in Optical Cables During Installation and in Service.....	18
A Locator of Faults in an Optical Fiber or Cable.....	19
Requirements to be Met by Optical Connectors.....	19
Energy Entrance Loss in an Optical Cable.....	20
Transmission Characteristics of Optical Cables Under Mechanical Loads.....	21
Optical-Cable Techniques in Communication Systems: Survey of the Telecom-79 International Exhibition.....	21
Methods of Approximate Calculation of the Probability of Correct Elimination of Ambiguity in Multiscale Phase Measurement Systems.....	22
Estimating the Distortion of Radio Pulse Signals Due to Dispersion.....	23
Correlation Properties of a Field Propagating in a Medium With Inhomogeneities of Many Scales.....	23
The Attenuation of Radio Waves in Rain in the Shortwave Portion of the Millimeter Band.....	24
A Wave Approach to Scattering of Short Radio Waves in Irregular Ionospheric Waveguides.....	25
On the Problem of Mode Separation by the Method of Doppler Filtration.....	25
Estimate of the Parameters of Distribution of Intensity of Bursts of Atmospheric Radio Interference at Very Low Frequencies.....	26

Exact Spectral-Correlation Analysis of Transmission of a Random Telegraph Signal Through an Amplifier With AGC.....	27
Some Particulars of Transmission of a Noise Signal Through a Parametric System.....	27
Combined Optimal Processing of Two Continuous Signals.....	28
Optimization of Data Transmission Systems With Respect to a Set of Technical-Economic Indices.....	28
The Application of Theoretical Numerical Transforms to Signal Synchronization and Decoding.....	29
Concerning the Question of Equivalence of Information Models to Actual Signals.....	30
Optimum Filtration of a Gaussian Process Against a Background of Interference Correlated With This Process.....	30
Dependence of Values of the Autocorrelation Function on the Block Structure of a Code Sequence.....	31
Determination of Probability Characteristics for Training Algorithms.....	32
Investigation of the Generalized Probability Distribution of Radio Signal Power.....	32
Discrimination of Signals by the Power Spectrum in the Karunian-Loev Basis.....	33
Rank Binary Detection of a Determinate Signal Against a Background of Markov Interference.....	33
The Interrelationship Between the Intensities of the Fluctuating and Pulsed Components of Atmospheric Radio Interference in the VLF Band.....	34
A Method of Evaluating the Applicability of Models of Atmospheric Radio Interference.....	35
Analysis of Influence of Harmonic Interference Autocompensator on Pulse Radio Signals.....	35

Search for Two-Dimensional Vector Parameter of Radio Signal.....	36
Continuous Control of the Rate of Data Transmission in Radio Links With Signal Fading.....	36
On Two-Stage Signal Search in a Multichannel System Taking Into Account Possible Shifting of the Signal from Channel to Channel.....	37
Interference Immunity of a Noise Signal Receiver Operating by the Method of Bilateral Space Contrast in the Presence of Lumped Interferences.....	37
Frequency Properties of Zoned Fresnel Lenses.....	38
Determination of the Phase of a Pseudorandom Sequence.....	39
Upper Bound of Complexity in Multiplying a Vector by a Binary Matrix.....	39
COMPONENTS AND CIRCUIT ELEMENTS, WAVEGUIDES, CAVITY RESONATORS AND FILTERS	
The Temperature Dependence of the Position of a Compressed Linear FM Signal in Surface Acoustic Wave Dispersion Delay Lines.....	40
A Dielectric Stripline Waveguide for the Shortwave Portion of the Millimeter Band.....	40
A Resonator Using Surface Spin Waves.....	41
The Design of a Resonator for a Radiospectroscope.....	42
An Adaptive Digital Rejection Comb-Filter.....	42
A Microwave Attenuator Based on Two Longitudinally Distributed p-i-n Structures.....	43
CONVERTERS, INVERTERS, TRANSDUCERS	
High-Power Thyristor Ultrasonic Frequency Converters With Chopping Diodes.....	44
Transformer-Thyristor Controlled Converters for A.C. Voltage.....	44

ELECTRICAL ENGINEERING, EQUIPMENT AND MACHINERY:
APPLICATIONS AND THEORY

A Phase Shifter Based on a Rotating Sine-Cosine Transformer With an RC-Circuit.....	46
Breakdown Characteristics and Endurance Testing of Pulse-Duty Cables With Polyethylene Insulation.....	46
Selecting Optimum Shapes for Insulators in High-Voltage Impulse Devices With Water Insulation.....	47
Optimum Shielding of Insulator Support Structures for Electrical Equipment.....	48
Design of Grounding Electrodes for Permafrost Soils.....	49
Calculation of the Electromagnetic Ponderomotive Force in the Active Zone of an Iron Separator With a Plane-Meridional Magnetic Field.....	50
Balancing of Load in a System of Traction Electric Drive of Self-Propelled Mine Cars.....	50
Magnetic Suspension Systems for Contactless Transport.....	51
Electrical Equipment and Energy Characteristics of a High-Power Electric-Arc D.C. Generator.....	52
Investigation of Resonance Ranges of Vibration of Small Induction Motors.....	52

ELECTROACOUSTICS

Specifics of Amplification and Generation of Acoustic Waves in the Geometry of a Korbino Disk.....	54
---	----

ELECTROMAGNETIC WAVE PROPAGATION, ELECTRODYNAMICS

Solution of the Inverse Problem of Refraction.....	55
Diffraction on a Small Aperture in a Conducting Screen in the Presence of Ferrite Spheres.....	55
Equivalent Electrical Parameters of Laminated Nonferromagnetic Media Penetrated by an Electromagnetic Pulse Field.....	56

Interaction of an Electromagnetic Field With a Nonheterogeneous Conducting Cylinder.....	57
Calculation of the Electromagnetic Field in Multilayer Media.....	57
One-Dimensional Problems of Pulse Penetration of Electromagnetic Field Into Moving Conductors.....	58
Homogeneous Problems of the Generalized Method of Natural Oscillations for Bodies of Rotation.....	59
The Synthesis of Resonant Electromagnetic Field Sources.....	59
Excitation of a Radially Heterogeneous Sphere With Electric and Magnetic Currents.....	60
Electromagnetic Interaction Between Elements of a Periodic System of Unbalanced Strip Lines.....	61
ELECTRON AND ION DEVICES: EMISSION: GAS-DISCHARGE AND ELECTRON-BEAM DEVICES	
Relativistic High-Current Electron Beams in Vacuum.....	62
ELECTRON TUBES: ELECTROVACUUM TECHNOLOGY	
Characteristics of Narrow-Band Noise Signal in an Q-Type Traveling Wave Tube.....	63
Static Cycloidality and Nonlinear Effect in Magnetron Type Beam Devices.....	63
ENERGY SOURCES	
Effect of Fluctuations of the Ambient Temperature on the Performance Parameters of Thermoelectric Generators.....	65
INFRARED	
A Metal-Oxide-Metal Diode as a Mixer in the Infrared Band.....	66
INSTRUMENTS, MEASURING DEVICES AND TESTERS, METHODS OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES	
Selecting a Radiation Source for an Interference Goniometer.....	67
Application of Two Oscillator Modes in Millimeter Interferometry.....	67

Radiative and Convective Heating of Specimens in Infrared Spectrophotometers.....	68
Optical Characteristics of Dielectric Coatings Irradiated by a Laser.....	69
The 'Stator-1' Thermal Scanner Measurement Data Support.....	69
Method of Logical Detection of Radio Pulses.....	70
Measuring the Width of the Stimulated Emission Spectrum of Pulsed and Continuous Laser Radiation.....	70
Optimization of Parameters of a Measurer of the Tangential Components of a Velocity Vector.....	71
Nonlinear Distortions in an Acoustooptical Spectrum Analyzer.....	72
Cryogenically Cooled Semiconductor Bolometers With an Isolated Target.....	72
Design of Measurers of the Parameters of Passive Interference Based on Alternating Period Compensation Circuits.....	73
On the Probability of Tracking Loss in a System With Second-Order Filter.....	73
Instrument for Testing Magnetic Characteristics of Transformer Steel.....	74
A Statistical Quality Criterion for the Optical Systems in Optoelectronic Photometers.....	75

MICROELECTRONICS

Timing Relay for Photolithographic Processes.....	76
---	----

OPTOELECTRONICS, QUASI-OPTICAL DEVICES

Selection of the Passband for an Optoelectronic System With Sinusoidal Scanning Law.....	77
The Calculation of Some of the Electronic-Optical Properties of the Multiple Lens Imaging Systems of Transilluminating Electron Microscopes.....	77

OSCILLATORS, MODULATORS, GENERATORS

A Resonator With Double Grating as the Oscillatory System of a Self-Excited Oscillator..... 79

Control of the Synchronization Parameters of Nonisochronic Oscillators..... 79

PHOTOELECTRIC PHENOMENA AND DEVICES, ELECTROLUMINESCENCE, ION DEVICES

The Mechanism of Exoelectron Emission from the Dynodes of a Photoelectric Multiplier..... 81

POWER SYSTEMS (INCLUDING EFFECT OF VARIOUS ITEMS ON POWER TRANSMISSION)

Estimation of the Error in Measurement of the Lightning Current Amplitude With a Loop Antenna..... 82

PRODUCTION TECHNOLOGY

Application of Sector Standard Models and Subordinate Sample Measurement Facilities to Semiconductor Production..... 83

A High-Speed Interference-Resistant Measurement Complex for Inspecting Metal-Film Resistors..... 83

QUANTUM ELECTRONICS

Interference Immunity in Holographic Interferometry..... 85

Amplification of Signals in the 10.6 Micrometer Band in Waveguide Discharge Tubes..... 85

A Study of the Sound Diffraction of High Power Laser Radiation in TeO_2 86

Widely Tunable Lasting at Submillimeter Wavelengths Using Pulsed CO_2 Laser Nonlinear Frequency Mixing..... 87

RADARS, RADIONAVIGATION AIDS, DIRECTION FINDING, GYROS

Use of the Interscan Correlation of Signals in Moving-Target Selection Systems..... 88

The Utilization of a Current Estimate of the Inverse Correlation Matrix of the Interference in an Adaptive Detector..... 88

The Study of the Range of Detection of the Seacoast by Radar..... 89

SEMICONDUCTORS AND DIELECTRICS, CRYSTALS IN GENERAL

The Passage of 10 to 25 KEV Electrons Through KBr Dielectric Films.....	90
Absorption of 10.6 Micrometer Radiation by High-Purity Germanium....	90
The Impact of the Pulsed Radiation of a Ruby Laser on the Electrophysical Characteristics of Silicon Transistors.....	91
A Theoretical Study of the Operational Modes of Gunn Diodes With Enriched Layers.....	92
On the Process of Switching Inverse Conductance Modulator Thyristors.....	93

VARIOUS MISCELLANEOUS ITEMS, INCLUDING THEORIES

Preparation of Optical Grids and Scales by 'Reverse' Photolithography.....	94
Design of Optical Fresnel Mirrors.....	94
Optical Characteristics of Interference-Type Notch Filters Made of Lead Telluride and Barium Fluorine Layers.....	95
Magnetization Reversal in a Ferromagnetic Plate in a Uniform Magnetic Field Varying Nonsinusoidally With Time.....	96
Changes in the Surface of Fiber-Optic Plates Due to Heat Treatment.....	96

ANTENNAS

UDC 621.396.67

SYNTHESIS OF A WEAKLY DIRECTIONAL ANTENNA WITH HIGH ELECTROMAGNETIC COMPATIBILITY

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOPHIZIKA in Russian Vol 23, No 10, 1980 pp 1250-1255 manuscript received 18 Dec 79

MARTSAFAY, V. V. and SOLODOVNIKOV, M. A., Odessa Electrical Engineering Institute of Communications

[Abstract] Interest in problems of synthesizing antennas is increasing with the expanding requirements for specific antenna characteristics. In addition to the conventional requirements for radiation patterns, conditions of electromagnetic compatibility have now become important. If EMC parameters are determined by the field in the shadow region, synthesis must be based on solution of the corresponding diffraction problem. This approach was used by Polishchuk and Cherenkov to find the field distribution in the aperture of a cylindrical antenna. In this paper the authors consider another approach to an analogous problem of antenna synthesis that optimizes the currents of sources, i. e. provides simultaneous solution of the external and internal problems of electrodynamics. The problem is solved in two stages. In the first stage, a solution is found for the diffraction problem, i.e. the fields inside and outside of the antenna that are produced by each source are determined. In the second stage, the optimum excitation is determined by methods of optimum programming, i.e. the currents are found for which the field amplitude at a point in the vicinity of a small radiator working in conjunction with the antenna is minimum and energy requirements are satisfied. The authors thank I. N. Polishchuk and V. S. Cherenkov for constructive criticism. Figures 4; tables 1; references 11: 9 Russian, 2 Western in translation. [103-6610]

UDC 621.396.67

INPUT IMPEDANCE OF A VIBRATOR PARALLEL TO THE EDGE OF A WEDGE

Kiev IZVESTIYA VYSSHIXH UCHEBNYKH ZAVERSHENIY: RADIOTEKHNIKA in Russian Vol 23, No 11, Nov 80 pp 19-23 manuscript received 1 Jun 79 after revision 14 Nov 79

BOLSUNOV, I. A. and ZARUBIY, A. M.

[Abstract] The input impedance of a vibrator in the vicinity of other bodies is calculated in the specific case of a thin cylindrical vibrator parallel to the edge of an ideally conducting wedge. The wedge is excited from a source of emf located inside an infinitesimally narrow gap in the middle of the vibrator. The system of rectangular coordinates is oriented so that the electric potential outside the wedge has only a component parallel to the wedge edge. The problem reduces to a solution of the integral equation for the current, the kernel of this equation being the Green function for an electric dipole and including geometrical optics as well as diffraction components due to the wedge. Here it has been solved numerically by the moments method with polynomial basis functions, reduction to a system of algebraic equations by the points matching method, and evaluation of integrals by the Simpson method. Results are shown for the special cases of a vibrator near a half-plane and a vibrator on the bisector of wedges with various angles including a right one. Figures 4; references 13: 6 Russian, 7 Western (1 in translation).

[117-2415]

UDC 621.396.67.01

THE DIRECTIONAL PATTERNS OF ANTENNAS WHEN OPERATING WITH VERY SHORT PULSES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1392-1396
manuscript received 3 May 78, after revision 25 Jul 79

ZHIDKO, Yu. M.

[Abstract] Where the wavelength of an antenna is commensurate with or greater than the pulse width employed, the sidelobe patterns and the waveform of the transmitted or received pulses are considerably different from the case of long pulses. This paper is a purely mathematical treatment of pattern behavior for the short pulse case using two examples: 1) A pulsed signal with a gaussian waveform in an antenna with an equal amplitude field distribution in the aperture; and 2) A pulsed signal with a gaussian waveform in the antenna array having an equal amplitude current distribution in the radiators. In arrays with widely spaced radiators, higher order interference maxima are blurred. This makes it possible to expand the field of view in side-looking radars with a synthesized antenna, though with a corresponding reduction in the contrast sensitivity. The derived theoretical expressions in the paper are neither graphed nor numerically compared with any experimental data. References 2: 1 Russian, 1 Western.
[317-8225]

A STUDY OF THE POSSIBILITY OF REDUCING BACKGROUND RADIATION FROM THE REFLECTING ANTENNA OF A WEATHER RADAR

Moscow RADIOTEKHNIKA i ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2548-2556
 manuscript received 10 May 78, after revision 2 Apr 80

PAVLOV, V. P., SAKHATSKIY, V. D. and YURCHAK, B. S.

[Abstract] The problem of reflection of the side and back lobes of radiation of a weather radar antenna by local objects is quite severe, causing false echos on the PPI and limiting the minimum range at which reliable weather observations can be made by radar. Possible means of reducing radiation except for main-lobe radiation include the use of absorbing materials such as parallel resistive-plate grids, absorbing cylindrical grids on the feed line, an absorbing cylinder at the center point of the antenna reflector and twin plates of absorbing material above and below the feeder horn at the focus of the antenna reflector. Approximately a 12 dB improvement in backscatter characteristics was observed with the absorbing materials present on the feeder structures. This allowed the backscatter zone of uncertainty to be shrunk by 350 m in radius. The use of other absorbing materials on other portions of the hardware at the radar site did not yield significant improvements in backscatter characteristics. The absorbing material must have a coefficient of reflection on the order of 1-2% or less over a broad range of angles of incidence to be useful, even if this is achieved at the cost of a decrease in the coefficient of absorption. Figures 6; references: 13 Russian. [142-6508]

EFFECT OF SPACE-TIME LIGHT MODULATOR AND NOISE ON CHARACTERISTICS OF RADIOOPTICAL ANTENNA ARRAYS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 23, No 12, Dec 80 pp 3-10 manuscript received 6 Jul 79, after revision 19 May 80

GRINEV, A. Yu. and VORONIN, Ye. N.

[Abstract] In the first part of this paper, only factors are considered which are caused by the operating conditions and parameters of a space-time light modulator with the presence of conjugate coverage with a double-band lead-in, nonlinearity of the modulation characteristics, and a zero order of diffraction. In the second part an evaluation is made of the threshold sensitivity of radio-optical antenna arrays, by which is understood the magnitude of the signal power at its input, which gives rise at the output to a signal equal with respect to power to the thermal and quantum noise at the output. The following items are considered in some detail: 1) Effect of conjugate representation; 2) Nonlinearity of space-time light modulator; 3) Zero order of diffraction; 4) thermal noise; and 5) Quantum noise of radiooptical antenna arrays with coherent and noncoherent photodetection. Figures 3; references 8: 7 Russian, 1 Western in translation. [150-6415]

THE PROBLEM OF THE DIFFRACTION SYNTHESIS OF ANTENNAS WITH A SUPPLEMENTAL CONDITION
PLACED ON THE LEVEL OF THE FIELD IN THE SHADOW ZONE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1405-1413
manuscript received 16 Jan 79

POLISHCHUK, I. M. and CHERENKOV, V. S.

[Abstract] An important problem in antenna synthesis from the viewpoint of electromagnetic compatibility is: find the field distribution in the aperture of an antenna which simultaneously provides both the requisite directional pattern and meets the additional requirement of a sufficiently reduced field level (as compared to the distributions usually employed) throughout the entire shadow region of the antenna. The general considerations in such a design are discussed and applied to the specific case of an antenna with a radiating opening in a right circular cylinder (a two-dimensional formulation). Analytical expressions are derived for the amplitudes of the fields and the phase characteristics in the antenna aperture. The essence of the technique is based on finding a system of partial fields in the aperture which meets the specifications and then using the partial directional patterns corresponding to the selected fields in order to approximate the desired pattern. The model treated is one where the antenna properties are rigorously analyzed as a diffracting system, something which theoretically allows for taking the shape of the body in which the aperture is located into account. Figures 4: references 7: 6 Russian, 1 Western in translation.

[317-8225]

CERTAIN ASPECTS OF COMPUTER HARD AND SOFT WARE:
CONTROL, AUTOMATION, TELEMECHANICS, TELEMETERING,
MACHINE DESIGNING AND PLANNING

UDC 681.327.6

FERROACOUSTIC DATA STORAGE DEVICES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTELEKTRONIKA in Russian Vol 23,
No 11, Nov 80 pp 65-68 manuscript received 1 Jun 79, after revision 16 Jun 80

PETROVSKIY, B. S.

[Abstract] The performance parameters of ferroacoustic memory cells are examined, including variability and tolerance limits, relative to reliable data storage and readout. The stability and the interference immunity of these devices subject to aging and temperature changes is found to be higher than that of MOS-transistor cells. Ferroacoustic storage devices are produced by three basic forms: wire (0.2-0.05 mm in diameter), tape (0.05-0.003 mm thick) and film (10^{-3} - 10^{-4} mm thick). Their performance characteristics favor them over MOS-transistors also for use in industrial applications such as automatic welding. Tables 2; references 8: 7 Russian, 1 Western.
[117-2415]

CERTAIN ASPECTS OF PHOTOGRAPHY, MOTION PICTURES AND TELEVISION

UDC 621.385.832.5:621.391.822

NOISE CONVERSION IN TRANSMITTING TELEVISION TUBES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol. 25, No 11, Nov 80 pp 2443-2452
manuscript received 18 Sep 78

KOROLENKO, V. N., PINTSOV, V. A. and PINTSOV, L. A.

[Abstract] Noises in transmitting television tubes are usually considered in an oversimplified scheme whereby the target is broken up into elements with subsequent summation of the variances of noise of accumulation and readout on each element. Such discretization can lead to considerable errors. In this paper the conversion of noise in transmitting television tubes during accumulation and during readout is treated as conversion of random fields. Formulas are derived for calculating the signal current and the variance of noise. The results of computer calculations are given for the way that the signal, noise and signal-to-noise ratio depend on the parameters and operating conditions of transmitting tubes. It is shown that the noise variance at the output of the storage tube is not equal to the sum of the variances of accumulation and readout noise, and is determined by a rather complicated expression with consideration of correlation interaction of the commutating beam with the stored potential (charge) relief. The influence of accumulation noise on the output noise depends on the method of commutation of charges from the target. This factor plays almost no part in the superorthicon, is weak in the isocon with nonideal separator, and is more appreciable in the vidicon. Figures 4; tables 2; references: 10 Russian.

[105-6610]

UDC 621.397.61:621.397.133

SPECIAL FEATURES OF CONSTRUCTION OF STEREO TELEVISION TRANSMITTING CAMERAS

Moscow TEKHNIKA KINO I TELEVEDENIYA in Russian No 12, Dec 80 pp 46-49

MAMCHEV, G. V., Novosibirsk Electrical Engineering Institute of Communications

[Abstract] An analysis is made of the special features of construction of stereo transmitting cameras. The requirements for such cameras, the condition of orthostereoscopy, the choice of an optical circuit and a possible block diagram of an orthostereoscopic camera are examined. It is concluded that in a transmitting stereoscopic camera it is necessary to accomplish automatic regulation of its individual parameters (focal distance of lenses, distance between the center of object and the front, principal plane of lenses, angles of rotation and inclination of the camera in the horizontal and vertical planes, distance between centers of the phototargets) with the object of realizing the conditions of orthostereoscopy and supporting an optical scheme with parallel axes of the lenses and with a shift of the lenses relative to the centers of the phototargets of the transmitting tubes. Figures 5; references 8: 7 Russian, 1 Western (in translation).

[151-6415]

UDC 621.397.332.122.049.7

SEMICONDUCTOR INTEGRATED MICROCIRCUIT FOR SCANNING LINE GENERATORS OF TELEVISION RECEIVERS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 12, Dec 80 pp 38-42

SKLAR, Ya. and YAKOVLEV, S. B., Moscow Electrical Engineering Institute of Communications

[Abstract] The paper describes the functional circuit of the K174AF1 integrated microcircuit of USSR manufacture which is intended for operation in the scanning line generators of color and black and white TV receivers. The circuit provides that with all control voltages the output stages are fulfilled on the basis of both transistors and thyristors. The drive circuit and the shaper circuit for the voltage mentioned are united in the microcircuit, which makes it possible substantially to decrease the dimensions and the energy consumption of the scanning line generator which is used as the driver stage of the units of the functional structure of the IC. Figures 10: tables 1.

[151-6415]

UDC 621.397.611 Videomagnitofony

ANALYSIS OF THE PROCESS OF RECORDING IN VIDEO RECORDERS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 12, Dec 80 pp 29-33

PIKMAN, Ya. M.

[Abstract] Multiple experiments made by the author on "Kadr-1", "Kadr-3" and "VR-2000" video recorders made it possible to discover a number of phenomena which require the accurate interpretation necessary for determination of the principal means which make it possible to create video recorders with higher parameters. The following relate to these phenomena: 1) During recording-reproduction of two frequencies, one of which copies the carrier, and the other the side frequency of the spectrum of the FM signal, the symmetrical side frequency is restored; 2) During a decay or rise of the amplitude-frequency and phase-frequency characteristics of recording in the region of the upper sideband a rise of the frequency characteristics of a demodulated video signal is observed; 3) The level of the combination band in a demodulated video signal is changed during a change of the amplitude-frequency and phase-frequency characteristics of the channel for recording the FM signal; and 4) With repeated overrecorded signals, worsening of the transient response is disproportionate to the number of overrecords. The paper proposes a theoretical model of the processes of recording and reproduction in video recorders, in which the determinant role of the decaying front of the dynamic field of the recording head is considered. The model is based on graphic methods of description in which two systems of coordinates are used: one is stationary and the other moves together with the working

gap of the video head. On the basis of the proposed model, the paper considers the process of recording ideal AM and FM signals. An analysis conducted on the basis of the processed model of the process of recording-reproduction of signals showed that during recording of a FM signal additional AM and FM components appear. During this the frequency characteristic of the process of recording a FM signal with an optimum recording current is symmetrical with respect to the carrier. During recording of AM signals additional FM and AM components appear, during which the index of the additional FM depends linearly on the frequency. The experimental investigations show good conformity with theory and experiment. Figures 5. [151-6415]

UDC 681.7.067.2:681.772.71.013.82

MEASUREMENT OF THE FREQUENCY-CONTRAST CHARACTERISTIC OF TV CAMERA LENSES

Moscow TAKHNIKA KINO I TELEVIDIENIYA in Russian No 12, Dec 80 pp 33-35

FEDOROV, K. A.

[Abstract] A description is given of a vidicon with a resolution chart system, which is convenient for measurement of the frequency-contrast characteristic of TV camera lenses. A L1421 vidicon was used as a base. With the aid of photolithography, a system of parallel resolution charts and a strip (large element) was applied to the glass disk of this tube in the form of a chromium layer with a thickness of 0.07 micrometer. The spatial frequency of the resolution chart is 30, 25, 20, 15 and 10 lines/mm. The height of each chart and strip is 300 micrometer; the distance between the resolution charts as well as between the strip and the resolution chart adjacent to it is 50 micrometer. The width of each resolution chart and strip is 2.5 mm. All of the resolution charts and strips are located on one half of the disk. Application of the signal plate and photoconductive layer was performed according to ordinary technology customary for a given type of tube. It is necessary that the electronic-optical system of the tube assures a sufficiently high resolution; the higher the resolution of the vidicon, the higher the precision of measurement of the frequency-contrast characteristic of the lens. The method of measuring the frequency-contrast characteristic is described. Figures 1; references: 6 Russian.
[151-6415]

CERTAIN ASPECTS OF RADIOASTRONOMY, SATELLITES
AND SPACE VEHICLES

THEORY OF UNIAXIAL OFFSET GUIDANCE OF ASTRONOMIC TELESCOPES

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSSR: SERIYA TEKHNICHESKIH NAUK
in Russian Vol 33, No 5, Sep-Oct 80 pp 10-22

GASPARYAN, O. N. and YEGIAZARYAN, G. G.

[Abstract] Offset guidance is a most effective method of stabilizing large astronomic telescopes and was used, for example, in the Stratoscope-II stratospheric observatory. Here the theory of uniaxial offset guidance with either one star or two stars as the reference is analyzed. The system consists essentially of a main mirror, a secondary mirror, and one 2-coordinate astral transducer for one reference star or two 1-coordinate astral transducers for two reference stars. Two important elements are the focal plane of the telescope and the annular zone of possible star locations. Two kinematic schemes are possible. One is designed for plane-parallel displacement of the transducer or the transducers along the two stabilization axes, one is designed for rotation of the transducer or the transducers about the optical axis of the telescope through appropriate angles with a subsequent radial displacement. Calculations of the steady-state error according to the theory of control reveal that the first scheme is preferable in a system with one reference star, inasmuch as there are no constraints on the choice of star. In a system with two reference stars the static error due to uncontrollable rotation about the telescope axis can be eliminated completely, but the first kinematic scheme requires a structural modification: one 2-coordinate transducer as before and one auxiliary 1-coordinate transducer in the focal plane of the telescope superposed on the image of the second reference star. Here the second kinematic scheme with two 1-coordinate transducer offers the advantages of greater simplicity and fewer measurable deviations, but interchannel coupling can cause large guidance errors and even loss of stability. In both schemes the transducers can lose both reference stars when the amplitudes of perturbations about the telescope axis become too large. Figures 9; references 8: 4 Russian, 5 Western.
(130-2415)

CIRCUIT THEORY AND PRACTICE

UDC 537.312.62:029.6:621.376.43

PHASE MODULATION AND COMPLEX SQUID CIRCUITS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2639-2646
manuscript received 24 Sep 79

BELONOBOV, S. A., SNIGIREV, O. V., TINCHEV, S. S. and LIKHAREV, K. K.

[Abstract] A study is made of the characteristics of a squid (radio frequency superconducting quantum interference device) utilizing phase modulation. Based on the analysis presented, the advantages of squids with amplitude and phase detection are compared, as well as squids with more complex radio frequency circuits. The analysis shows that with phase demodulation, the spread of the signal characteristics should be equal to 0 where $\xi=0$, then increase almost linearly with an increase in the detune modulus. The maximum spread of the signal characteristic can be achieved by the use of a simple amplitude detector. Squids operating in the hysteresis mode not only modulate the amplitude of oscillations in the resonant circuit, but also perform significant phase modulation as well. This phase modulation can achieve significant spread of signal characteristics of the squid and therefore better sensitivity than amplitude detectors. However, if parameter k can be varied, it is better to operate with a simple amplitude vector at $k^2Q=\pi/4$ and $\xi=0$. Figures 3; references 8: 3 Russian, 5 Western.
[142-6508]

UDC 621.3.013

ELECTROMAGNETIC FIELD IN MAGNETIC CIRCUITS IN THE CASE OF THEIR MAGNETIZATION BY A GIVEN CURRENT

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11,
Nov 80 pp 13-18 manuscript received 24 Jun 80

GERASIMOVICH, A. N., candidate of technical sciences, docent

[Abstract] The electromagnetic field in magnetic circuits is calculated from the Maxwell equations, usually by the operator method in the case of nonsinusoidal voltages and magnetizing currents. Inverse transformation to functions of time can become difficult or impossible when the waveform of the magnetizing signal is not simple. Here the problem is solved by replacing the curve of current as a function of time with a step curve. This method, applicable to any form of the current curve, is demonstrated in the case of a plate with dimensions which allow the electromagnetic wave in it to be regarded as a plane one. The plate is made of a material with constant electrical conductivity and magnetic permeability. For a given magnetizing current, the system of equations is resolvable with respect to the magnetic field intensity. The method can be extended further to the case where the magnetization period covers intervals of time with different laws of current variation. The paper was submitted by the Department (Kafedra) of Electric Power Plants, Order of the Red Banner of Labor Belorussian Polytechnical Institute. Figures 2; references: 4 Russian.
[126-2415]

COMMUNICATIONS, COMMUNICATION EQUIPMENT, RECEIVERS AND
TRANSMITTERS, NETWORKS, RADIO PHYSICS DATA
TRANSMISSION AND PROCESSING, INFORMATION THEORY

UDC 535

INTERPRETATION OF POLARIZATION CHARACTERISTICS OF OPTICAL SIGNALS IN LIDAR
DETECTION OF DISPERSED MEDIA

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23,
No 10, 1980 pp 1139-1146 manuscript received 17 Sep 79

VERETENNIKOV, V. V. and NAATS, I. E., Institute of Optics of the Atmosphere,
Siberian Department, USSR Academy of Sciences

[Abstract] On-the-spot evaluation of the microstructural parameters of dispersed media by lidar facilities is of particular interest for solution of practical problems of the theory of propagation of optical emission in the atmosphere in the presence of smog, mist, clouds and the like. The importance of the problem is increasing with the trend toward remote monitoring of aerosol pollution of air. The authors of this paper propose an algorithm for reconstructing the size distribution function of aerosol particles from bistatic lidar measurements. The technique is based on inversion of the polarization characteristics of received optical signals. Some general requirements are formulated for accuracy of measuring instruments in lidar detection of aerosols in the lower troposphere. Figures 6; references 8: 5 Russian, 1 Western (in translation).
[103-6610]

UDC 519.217.2

THE QUANTUM FILTERING OF MARKOV SIGNALS AGAINST A BACKGROUND OF WHITE QUANTUM NOISE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1445-1453
manuscript received 5 Jan 78, after revision 2 Mar 79

BELAVKIN, V. P.

[Abstract] The difficulties encountered in previous attempts to develop a multi-stage dynamic variant of quantum measurement and decision making theory applicable to problems of filtering in discrete time can be circumvented by treated a broader classes of sequential compatible quantum measurements, allowing these measurements to be a function not only of time, but also of the results of previous measurements. Such a quantum device is naturally termed a quantum filter with a memory. It is demonstrated that in the case of a multidimensional Markov gaussian signal against a background of white quantum noise, the optimal filter is a coherent Markov filter, i.e. the future quantum measurements are determined only by the present result and do not depend on earlier measurement results. Such a filter can realize both the coherent measurement of a field with the addition of zero level quantum noise and subsequent processing of the measurement results using a classcial linear multidimensional Kalman-Busy filter. The example treated is an electromagnetic oscillator loaded into a pair of independent transmission lines

which are uniform and ideally matched to the load, which is the measurement system connected to their output. The optimal measurement of the amplitude of this quantum oscillator at the output of the line is determined. Rigorous mathematical definitions are given for quantum measurement processes and filters which do not anticipate the measurement process ("non-anticipating quantum filters"). A theorem defining an optimal quantum filter for a Markov gaussian process is also stated and proved. Figures 1; references 10: 4 Russian, 6 Western.
[317-8225]

UDC 537.874.3:519.2

THE INFLUENCE OF DAILY VARIATIONS IN ENVIRONMENTAL PARAMETERS ON THE STATISTICS OF ANGLES OF REFRACTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2498-2503
manuscript received 1 Oct 79

BADULIN, N. N. and TATARINOV, V. N.

[Abstract] A parametric model of the process of random refraction is suggested. Variations in the parameters of random refraction generated by this model can approximate practically all types of distribution of refraction angles observed in experiments. First, the Einstein-Fokker equation is analyzed. This equation has been demonstrated to be valid as a description of the propagation of waves in a random heterogeneous medium. The solution of the equation is a gaussian distribution. However, the local characteristics of the process are time dependent if the characteristics of the environment vary with time, resulting in evolution of the parameters of the distribution. In the second portion of the article, the solution of the equation averaged over time is studied on the assumption that the daily variations follow a sine wave. The summary process in this case is non-gaussian, but rather follows a bimodal distribution with clear asymmetry. Finally, the model suggested is compared with experimental studies. Round the clock sessions of measurement of the fluctuation of angles of arrival in the 3 centimeter wave band were performed over paths 12 and 20.7 km in length in January of 1979. Experimental and calculated data agree satisfactorily, although the variation in dispersion of the process as a function of time of day is more random in nature, since it depends greatly on weather conditions, season of the year, type of underlying ground surface, etc. However, different day and night dispersions are almost always observed, causing asymmetry in the distribution of the process averaged over time. The parametric model of distribution of the angles of random refraction is quite flexible and explains the differences in the distribution of fluctuations of angles of refraction during the course of the day. Figures 3: references: 8 Russian.

[142-6508]

ON THE PROBLEM OF EVALUATING THE AVERAGE POWER OF SIGNALS IN m -FADING

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2279-2285
manuscript received 13 Mar 78, after revision 3 Jan 80

IVANKIN, P. A. and LEBEDINSKIY, Ye. V.

[Abstract] In analyzing the properties of signals reflected from the ionosphere with the a priori assumption of Nakagami distribution, the parameters of the distribution must be estimated. In this paper the authors propose a procedure for estimation based on the method of moments. An expression is derived that relates the confidence coefficient of the Nakagami parameter $\sqrt{M[x^2]}$ (where M is the mathematical expectation) to the sample space s with predetermined relative accuracy ϵ . It is shown how the confidence coefficient for the average power estimate depends on the required accuracy and on the bias of the estimate. Figures 2; references 8: 6 Russian, 2 Western.
[105-6610]

METHODS OF MEASURING THE ATTENUATION IN OPTICAL CABLES (SURVEY)

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 43-46 manuscript received
4 Aug 80

GRIGORASH, V. V. and FEDOROV, B. P.

[Abstract] For measuring the attenuation coefficient of optical cables, one mounts a segment of such a cable with an immersion fluid in an apparatus which generally also includes a radiation source, inlet optics, a photodetector, an amplifier, and an oscilloscope or xy-plotter. The six basic methods of measurement are: 1) Comparing or clipping the levels of an optical signal (coming from a GaAs laser directly or from a white source through a monochromator with interference-type filters) at the cable entrance and exit, which requires two photodetector channels feeding into the difference amplifier; 2) Measurement of the backscattering and the Rayleigh scattering by local inhomogeneities along the cable; 3) Measuring the radiation intensity in the far-field zone within a certain cone; 4) Measuring the temperature of the cable test specimen heated by an infrared radiation flux with a bolometer probe connected to a bridge circuit which feeds signals to the amplifier or measuring the temperature difference between a cold fiber and a fiber heated by a laser beam; 5) Graphical determination by plotting of the attenuation curve $\alpha = A/\lambda^4 + B$ dB/km, where the components A/λ^4 and B are respectively due to Rayleigh scattering (λ denoting the wavelength) and waveguide scattering by geometrical inhomogeneities, with attenuation due to absorption depending on the material and the quality of its treatment; and 6) Photometry involving a subjective comparison of glow intensities at the

exists from two fibers, a long one and a short one, upon insertion of absorbing filters into one channel. The main sources of error are losses incurred between the radiation source and the cable segment, including the loss due to incoherence of the light source, fast extinction of modes in the sheath at the cable entrance, and losses between the cable segment and the photodetector. Amplitude and time errors as well as instrument errors are systematic ones, the former two difficult to account for. It is recommended that measurements be performed at a temperature of $23 \pm 2^\circ\text{C}$ and a $50 \pm 5\%$ relative humidity under a pressure of 952-1158 GPa, to ensure a satisfactory repeatability of readings. Figures 5; references:

8 Western.

[127-2415]

UDC 621.315.2:535.8

OPTIMIZATION OF LOSSES IN SPLICES ALONG OPTICAL-CABLE LINES

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 40-43 manuscript received
5 Jun 80

MARTYNOVA, T. A. and CHERENKOV, G. A.

[Abstract] Minimization of losses in optical-cable splices is considered, assuming these losses under real conditions to be due to three factors only: gap between fiber ends, differences between the diameters and the refractive indexes of fiber cores, and radial misalignment between fiber axes. For simplification, the fiber axes are assumed to remain parallel to each other and perpendicular to the fiber end surfaces. The electrodynamic problem for a fiber-optics conductor with multiple connections is reduced to a two-dimensional problem with respect to the axial component of the electric field component of the n -th mode, with collocation at the boundary between a fiber core and its reflecting sheath. This problem is solved in the form of recurrence relations for the amplitudes of all modes. Disregarding diffraction at the core-sheath boundary and assuming a gap width between fiber end much smaller than the fiber diameters, a formula is derived for the total power of all modes in terms of a transmission coefficient. This solution serves as the basis for establishing the tolerances on misalignments between fiber axes. The optimization problem is formulated, accordingly, as one of finding the misalignments which, while remaining much smaller than 10% of the average fiber core diameter, will yield the required overall transmission coefficient with constant values of six other system parameters: refractive indexes of fiber core, fiber sheath, and gap medium between fiber ends, core diameter, sheath diameter, and number of modes. Numerical values have been obtained with the aid of a high-speed computer for a typical splice. The authors thank V. V. SHEVCHENKO for assistance with this study and for the discussion of the results. Figures 3; references 7: 1 Russian, 6 Western.

[127-2415]

FOREIGN EXPERIENCE IN LAYING AND INSTALLATION OF OPTICAL CABLES (SURVEY)

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 53-57 manuscript received
21 May 80

KOVYRZIN, A. A. and KSENOPOFTOV, S. N.

[Abstract] Experience in laying and installation of optical cables, particularly in Turin (Italy) and in Chicago (United States), indicates that it is possible to utilize electrical conducts with certain precautions. Supports consisting of an aluminum rod and a freely bending plate each should be spaced 8 m apart. Plastic tubing (polyethylene or polyvinyl chloride) should be inserted in order to avoid damage to the telephone duct. Tie sleeves with cable slack for reducing the tension and stay wires for protection against mechanical overloading should be installed at all bends and every 75-90 m along a straight stretch. Lubrication with 1% molybdenum disulfide in vaseline reduces friction. Important are splicing and connecting, for which special tools and procedures have been developed. Monofiber or multifiber biconical connectors are generally used. The requirements are similar for laying and installation of cables underground, the trench should be at least 0.6-1.2 m deep. Long optical cables in ducts or underground are laid, preferably beginning at the center of a line, first one half in one direction and then the other half in the other direction. These techniques are in many aspects very different from those used for laying and installation of conventional communication cables. Figures 6: references: 9 Western. [127-2415]

EXTERNAL FIELD AND INTERFERENCE IMMUNITY OF TWISTED OPTICAL FIBERS

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 24-27 manuscript received
21 May 80

GRODNEV, G. I.

[Abstract] Optical cables are made flexible by twisting of the fibers. The flow of energy along such fibers becomes disrupted at bends and a part of the energy leaks out here through radiation into the surrounding medium. This alters the field distribution around such a cable, inasmuch as a second wave appears which combines with the main propagating wave. Here the new field distribution caused by twisting of fibers is calculated for the specific case where an E-wave propagates along an axially oriented infinitesimally thin fiber in a longitudinal E_z -field and the tangential E_ϕ -field produced by a twist gives rise to an H-wave. The resulting two radial energy fluxes are calculated according to the Poynting theorem and compared with the energy flux from a straight axial fiber. The electric energy flux increases monotonically with increasing pitch, approaching

that radiated from a straight axial fiber, while the magnetic energy flux first increases to a maximum when the pitch is equal to the circumference and then decreases to zero as the pitch increases to infinity. Thus the magnetic component is dominant at small pitches and the electric component is dominant at large pitches. Both the resultant field intensity and energy flux decrease exponentially with increasing distance from the fiber axis. In the practical case of helically wound optical fibers the trend is essentially the same, the radiated energy flux here being comprised of the magnetic component only. Furthermore it increases proportionally to the frequency squared and with increasing radius of the helix. Twisting of fibers, which reduces the intensity of the electromagnetic field outside, thus effectively suppresses interference due to crosstalk and from external sources. It also produces radiation, however, and thus a source of interference in the environment. A compromise is, therefore, required in the design of optical cables with twisted fibers for optimum performance. Figures 5; tables 1; references: 5 Russian.
[127-2415]

UDC 621.356.820

LAW OF DISTRIBUTION OF FLUCTUATIONS IN THE INTENSITY OF OPTICAL EMISSION PROPAGATING IN A TURBULENT ATMOSPHERE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2273-2278
manuscript received 10 Jul 79

MILYUTIN, Ye. R. and YAREMENKO, Yu. I.

[Abstract] The problem of probability distribution of the intensity fluctuations in electromagnetic radiation inevitably arises in analysis of atmospheric optical communication lines. While energy relations in such lines can be determined from the first two statistical moments of intensity of the received signal, calculation of the error probability requires that we know the intensity probability distribution at the reception point. Previous theoretical and experimental research has shown that in a fairly wide region of strong fluctuations, the actual distribution cannot be described by either a logarithmically normal or exponential law, especially in the tails of the curves, where error probability determines the behavior of the distribution. On the basis of a phenomenological model of wave propagation in the optical band in a turbulent atmosphere, the authors find the law of distribution of fluctuations in the intensity of optical emission, and the way that this law depends on the characteristics of the medium of propagation and the transmission path. A numerical example is given. Figures 2; references 8: 6 Russian; 2 Western.

[105-6610]

OPTOELECTRONIC DEVICES FOR OPTICAL-CABLE COMMUNICATION SYSTEMS

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 36-38 manuscript received 18 Jun 80

SHVEYKIN, V. N. and ZARKEVICH, Ye. A.

[Abstract] The basic components of an optical-cable communication system are optoelectronic transmitting and receiving devices, namely the radiator and the photodetector, connected through the optical cable. The performance of optical radiators is evaluated in terms of specific power ($W/\text{sr.m}^2$) entrance coefficient at the cable end, stability, and current efficiency. Accordingly, the choice between a light-emitting diode, a superluminесcent diode, or a laser, specifically for a communication system operating at a $0.83-0.85 \mu\text{m}$ carrier wavelength, is based on a tradeoff which also includes the cost factor. The performance of photo-receivers is evaluated in terms of sensitivity (signal-to-noise ratio at a given power level), which depends on the dark current as well as on noise characteristics of the amplifier stages behind the photodetector. In communication systems operating at a $0.83-0.85 \mu\text{m}$ carrier wavelength it is preferable to use silicon rather than germanium devices, because of the lower dark current, an avalanche-transit photodiode followed by an amplifier stage on a field-effect transistor being particularly suitable for high-speed digital data transmission. Devices for matching the radiator and the photodetector to the optical cable are a glass cylinder, a segment of a fiber, or a focon. The latter is most advantageous, although it has the most intricate profile for the optimum entrance coefficient, because it constitutes in effect an optical transformer. Finally, in multitrunk systems interference is prevented by the use of multicontact connectors for joining them together and for their hookup to a multifiber cable.

[127-2415]

ADDITIONAL LOSSES IN AN OPTICAL CABLE

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 20-23 manuscript received 1 Jul 80

TEUMIN, I. I.

[Abstract] The losses in an optical cable are calculated which add to the loss due to attenuation in a fiber alone. These losses are caused by absorption and scattering, increasingly due to the latter as the former is reduced. They depend on the physical properties of the materials and on the geometrical characteristics of the cable layout. As a specific example, a stepwise profile of the refractive index is considered in the case of fibers inside a reflecting sheath with a perfectly absorbing coating. Losses are calculated which result from microbends,

from flaws and inherent structural features such as macrobends, also losses for which the technological process and especially the protective coating is responsible in the way of producing twists of fibers and internal stresses in them as well as fine surface irregularities highly sensitive to temperature changes. The total aggregate additional loss in existing optical cables is estimated at 0.5 dB/km maximum, with an attenuation in fibers of up to 10 dB/km, but further improvements in the technology should reduce this additional loss to within 0.1 dB/km. Tables 1; references 14: 3 Russian, 11 Western. [127-2415]

UDC 621.372.8:535

AN INSTRUMENT FOR MEASURING THE ATTENUATION IN OPTICAL CABLES DURING INSTALLATION AND IN SERVICE

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 46-48 manuscript received 5 Aug 80

VERNIK, S. M., KOSOLAPDNKO, G. B. and SHUTIN, R. I.

[Abstract] An instrument has been developed at the Leningrad Institute of Electrical Engineering imeni Prof M. A. Bonch-Bruyevich for measurement of the attenuation in optical cables. This IZVOK-2 set is designed for factory and field measurements. It consists of a source of optical test signals with a fiber outlet, which generates rectangular 150-160 μ W pulses at a repetition rate of 3409 Hz and with a duty factor of 0.5, and a heterodyne receiver which includes a photoelectric converter in the input stage followed by an intermediate-frequency (76 Hz) stage and a digital d.c. voltmeter indicating the level of the fundamental signal component. The measurement involves determining the difference between relative signal levels with the receiver connected to the generator through a reference fiber and through the test fiber respectively. Stabilization of the generator and reduction of the absolute magnitudes of losses at the cable connection points as well as of the differences between the corresponding losses, by proper preparation of the fiber ends and use of an immersion fluid, reduce the random error far below its maximum allowable level. During installation tests the fibers are first checked for continuity in all cable segments, then the attenuation coefficient is measured directly during splicing and finally during channel alignment. In service tests the measurement must be repeated so as to reveal the variation of the attenuation coefficient with temperature, time, and operating conditions. Figures 4; references 3: 2 Russian, 1 Western. [127-2415]

A LOCATOR OF FAULTS IN AN OPTICAL FIBER OR CABLE

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 49-50 manuscript received 25 Jul 80

OLEYNIKOV, A. D., PERSHAKOV, V. V., ROMANOV, V. S. and SKLYAROV, O. K.

[Abstract] A locator of faults due to flaws or breaks in an optical cable has been developed at the Central Scientific-Research Institute of Communications. It measures the time lag between an optical probing or reference pulse and the pulse and the pulse returning from the fault location upon reflection. It consists of a modulator-controlled 80 mW semiconductor laser ($\lambda = 0.85 \mu\text{m}$ wavelength and $\tau = 10^{-8}$ s pulse duration), a photodetector, a bifurcator for spatial separation of probing and returning pulses prior to their impingement on the photodetector, a wideband amplifier of electric output signals from the photodetector, a scanner which removes ambiguities arising from reflection of a pulse by several defects at various different locations and which receives pulses also from a master oscillator through a delay line, and a digital chronometer reading the time lag. The master oscillator generates the reference pulse and also feeds pulses to the laser pump amplifier. The maximum cable length covered by this instrument depends on the optical characteristics of the fiber as well as on the performance characteristics of the instrument components, including the minimum signal-to-noise ratio required. The measurement accuracy depends on the duration of the probing signal, on the speed of the photodetector and of the chronometer, also on the passband of the fiber. The probing signal is designed to be a quasi-Gaussian one of 10^{-8} s duration so as to ensure a measurement accuracy within ± 1.0 m, a dead zone not exceeding 2.0 m, and a resolution of 1.0 m. An oscillograph is provided for graphical readout. Figures 2.

[127-2415]

REQUIREMENTS TO BE MET BY OPTICAL CONNECTORS

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 38-40 manuscript received 30 May 80

PLOSHAY, L. L., SMIRNOV, V. I., FILIMONOV, V. P. and CHERTOV, V. G.

[Abstract] In optical-cable communication systems it is necessary to splice cables in order to cover the entire range within the reach of the system's energy potential. Such splices must ensure matching of the connected fibers with regard to refractive indexes. Here the requirements with respect to energy loss are examined and, on this basis, the performance of connectors in terms of attenuation is evaluated. All four loss components are included: entrance loss, splice loss, connector loss, and exit loss. Numerical data are given typical of connectors joining avalanche photodiodes and p-i-n photodiodes to optical

cables of various lengths from 0.5 to 3.0 km with a standard attenuation of either 4 or 10 dB/km. These data indicate what the permissible maximum attenuation in a connector must be. Measurements are shown, furthermore, which indicate the effect of cable manufacturing (precision of the losses in a connector). In the case of high-attenuation (19 dB/km) cables the required precision of cable ends is found to be attainable, for either permanent or split connectors, in the case of short low-attenuation (4 dB/km) cables welding of fibers is recommended after their mutual alignment. Figures 2; tables 1; references: 6 Western, [127-2415]

UDC 621.372.8:621.315.61

ENERGY ENTRANCE LOSS IN AN OPTICAL CABLE

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 27-30 manuscript received 4 Jul 79

SEMELEV, N. A.

[Abstract] The unavoidable energy entrance loss in an optical cable is calculated for the case of radiation coming from an incoherent or semicoherent source in a medium such as air. Radiation from the source is treated according to antenna theory, and radiation incidence at the fiber entrance is treated according to the Brillouin concept of additive partial waves, with the fiber-optics conductor consisting of an outer sheath having a constant refractive index and an inner core having a variable refractive index. Local losses as well as losses due to reflection are considered, also radiation from the fiber and intermode coupling due to molecular and macroscopic inhomogeneities, the power transfer from one mode to another being described by the diffusion equation and the solution to the latter sought in the form of a series in eigenfunctions. As a specific example, a light emitting diode is considered as the source of energy with its active surface having the radiation pattern of a Lambert source, an isotropic source, or an intermediate type of source, and numerical estimates of entrance loss in an optical fiber with a power-law profile of the refractive index. Figures 3; references: 2 Western.

[127-2415]

TRANSMISSION CHARACTERISTICS OF OPTICAL CABLES UNDER MECHANICAL LOADS

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 16-19 manuscript received
5 Jul 80

GOR'DVARB, I. S.

[Abstract] The effect of mechanical loading on the transmission characteristics of optical fibers is evaluated on the basis of theoretical calculations and experimental measurements. The two principal modes of loading encountered in practice are a longitudinally and circumferentially uniform normal pressure exerted by a tight protective sheath and a unilateral transverse force exerted extraneously or by a neighboring fiber in the cable. The theoretical analysis, applied to a 2-layer conductor, is based on Hooke's law and the photoelastic effect, both in terms of tensor components. Relations are established between the difference of refractive indexes of cable core and cable sheath, the principal parameter determining the radiation intensity attenuation along a fiber and the radiation intensity at the fiber exit end. Calculations and measurements pertaining to quartz fibers, bare and freely or tightly sheathed with a polymer, indicate that uniform axisymmetric pressure does not significantly affect the performance of bare fibers but a unilateral transverse force does and should always be avoided. Uniform axisymmetric pressure will be detrimental only when it is very high and needs to be reduced, by free rather than tight sheathing of optical fibers, only in special applications such as underwater cables.

Figures 4; references 4: 3 Russian, 1 Western.

[127-2415]

OPTICAL-CABLE TECHNIQUES IN COMMUNICATION SYSTEMS: SURVEY OF THE TELECOM-79
INTERNATIONAL EXHIBITION

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 80 pp 50-53 manuscript received
25 Aug 80

GORBUNOV, O. I. and SVETIKOV, Yu. V.

[Abstract] The 1979 International Exhibition in Geneva (Switzerland) revealed four basic trends in optical-cable communication systems: 1) Improvement of optical cables in terms of lower attenuation coefficients, wider frequency ranges, better geometry, and more efficacious construction; 2) Development of reliable low-loss permanent and split connectors; 3) Development of special measuring instruments; and 4) Development of optical cables for digital and analog data transmission, mainly in television systems. On the basis of a survey of all manufacturers, the present state of the art is characterized by attenuation as low as 3 dB/km, a parabolic profile of the refractive index, and a transmission

rate as high as 140 Mbit/s with a dispersion not exceeding 1 ns/km, with fiber dimensions held within $\pm 2 \mu\text{m}$ tolerances. Pioneers in this field were the two British firms TCL and GEC, both having developed digital cable systems for transmission at rates of 8, 34, and 140 Mbit/s as well as transmitter and receiver equipment. Other exhibitors includes the British firm Plessey, F&G (West Germany), Philips and NKF (Netherlands), SATO (France), and Corning Glass (United States). Gradiental fibers for use with laser diodes or p-i-n photodiodes have been developed, one such a system especially for West Berlin, also cables consisting of 12 monofibers for use in a 16 km long automatic telephone line and other cables consisting of 6 or 18 monofibers. New square connectors have been developed by the old French firm Fouriau. Terminal equipment was exhibited by Telletra (Italy) and NEC (Japan). Other exhibitors included Industrie Face Standard S.p.A., Harris (Canada), and only a few US manufacturers: Bell Laboratories and T&B. The USSR exhibited its IKM-30,120,480 digital data transmission systems including terminal and intermediate equipment for the optical channel, and excelling the foreign-made equipment in precision of manufacture of all bays and in completeness of servicing equipment. Tables 1; references: 1 Russian. [127-2415]

UDC 621.317.77

METHODS OF APPROXIMATE CALCULATION OF THE PROBABILITY OF CORRECT ELIMINATION OF AMBIGUITY IN MULTISCALE PHASE MEASUREMENT SYSTEMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2323-2328
manuscript received 15 Dec 78

DENISOV, V. P.

[Abstract] Exact calculation of the probability of correct elimination of ambiguity of measurements in multiscale phase systems is reduced to computation of a multi-dimensional normal integral. It is assumed that the phase systems are used to evaluate some quantity by the method of maximum likelihood from a set of measured phase differences on two or more scales, each of which is ambiguous. The errors of phase measurements are random and conform to a normal distribution law with zero mean values and known correlation matrix. The procedure for finding the maximum likelihood of the given quantity involves finding a multidimensional whole-number vector with coordinates that are the numbers of the complete periods of the phase differences lost during measurement. Methods are described for getting estimates from above and from below for the probability of correct elimination of ambiguity based on approximately the region of integration by ellipsoids. Simple engineering formulas are derived for probability estimation. Figure 1, references 7: 6 Russian, 1 Western in translation. [105-6610]

ESTIMATING THE DISTORTION OF RADIO PULSE SIGNALS DUE TO DISPERSION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian
Vol 23, No 11, Nov 80 pp 24-27 manuscript received 2 Aug 79, after revision
3 Dec 79

SUKHOREBROV, V. G.

[Abstract] The distortion of radio pulses due to dispersion in microwave transmission lines is calculated by approximate methods. In the case of "weak" dispersion, more than the optimum number of duty cycles, the phase characteristics of the transmission line can be represented by a quadratic Taylor series with respect to the signal carrier frequency and only the symmetric component of distortion needs to be considered. In the case of "strong" dispersion, fewer than half the optimum number of duty cycles, the asymmetric component of distortion must be taken into account and this can be done by the asymptotic method with a steady phase. This has been demonstrated by computer calculations according to exact relations, assuming a Gaussian envelope of the radio pulse at the output end of the line. The quadratic approximation is particularly expedient for radio pulses with more than 10-20 duty cycles and a carrier frequency well above the critical one for a given line. It is then applicable over the entire range of signal time delays. Figures 4; references: 3 Western.
[117-2415]

CORRELATION PROPERTIES OF A FIELD PROPAGATING IN A MEDIUM WITH INHOMOGENEITIES OF MANY SCALES

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOPHIZIKA in Russian Vol 23, No 10, 1980 pp 1177-1184 manuscript received 1 Aug 79

VINOGRADOV, A. G. and TEOKHAROV, A. N.

[Abstract] Wave propagation in the troposphere and ionosphere takes place in a medium with a wide range of fluctuations in the size of dielectric inhomogeneities. Shortwave asymptotic methods are not suitable for calculating the fluctuations of meter and centimeter waves in such media, and the Born approximation is applicable only for weak scattering. In this paper the authors analyze the correlation properties of the scattered field in the zone of direct visibility in a randomly inhomogeneous medium containing inhomogeneities of the dielectric constant both larger and smaller than a wavelength of the propagating radio emission. The analysis is based on a "hybrid" method developed by Vinogradov and Kravtsov [IZVESTIYA VUZOV: RADIOPHIZIKA, Vol 16, No 7, 1973, p 1055], synthesizing the shortwave asymptotic methods and the Born approximation. An expression is found

for the correlation function of a spherical directed wave distorted by the fluctuating medium. The limits of applicability of the method are defined for studying the correlation properties of a scattered field. Conditions are found for which the analysis can be restricted to scattering by large-scale or by small-scale inhomogeneities. References: 8 Russian.
[103-6610]

UDC 621.371.029.65

THE ATTENUATION OF RADIO WAVES IN RAIN IN THE SHORTWAVE PORTION OF THE MILLIMETER BAND

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1522-1524
manuscript received 24 Jan 79

GUSHCHINA, I. Ya., ZRAZHEVSKIY, A. Yu., MALINKIN, V. G., PARSHCHIKOV, A. A., ROZANOV, B. A., SOKOLOV, A. V. and PETISOV, I. N.

[Abstract] Experimental and theoretical studies of millimeter band waves in rain were made in the spring of 1977 for a path length of 7.7 km. The receiving and transmitting points were 10 and 2.5 m above the ground surface, respectively, and the average path clearance was 15 m. The transmitting and receiving system consisted of two single-reflector parabolic dishes: a transmitting dish 0.6 m in diameter and the receiving antenna of the Moscow Higher Engineering School radiotelescope with a diameter of 7.8 m. A 10 mw backward-wave tube served as the transmitter and the receiver was a modulation radiometer with a sensitivity of about 10^{-11} watts. The half-power beam widths of the patterns were 16' and 5' for the transmitting and receiving systems respectively, with a system signal-to-noise ratio of 40 dB for the given path. The attenuation in rain is shown graphically as a function of rain intensity at 10° C and also as a function of the imaginary component of the complex index of refraction of water. The impact of the real and imaginary components of the index are discussed and a simple approximation is derived for the attenuation at a wavelength of 2.2 mm: $a_0 = 1.2J_r^{0.635}$ where a_0 is in dB/km and J_r is the rain intensity of mm/hr. This expression can be used to calculate the per unit length attenuation in rains of different intensities. The authors thank M. A. KOLOSOV and A. M. KUGUSHEV [deceased] for attention to the work, as well as K. N. RYKOV for assistance while conducting the experiment. Figures 2; references 11: 6 Russian, 5 Western.
[317-8225]

A WAVE APPROACH TO SCATTERING OF SHORT RADIO WAVES IN IRREGULAR IONOSPHERIC WAVEGUIDES

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 10, 1980 pp 1147-1157 manuscript received 14 Sep 79, after completion 25 Mar 80

BORISOV, N. D., Institute of Terrestrial Magnetism, the Ionosphere and Propagation of Radio Waves, USSR Academy of Sciences

[Abstract] Ionospheric inhomogeneities of various scales determine shortwave propagation of the waveguide type. If the properties of the medium change slowly, this process can be described by the method of the adiabatic invariant, where the field in any cross section of the waveguide can be represented as a superposition of adiabatic modes. However, a more general approach is needed where nonadiabatic inhomogeneities are present in the channel. In this paper an explicit expression is found in the WKB approximation for the wave field in an arbitrary smoothly varying refraction waveguide. The effect of mode energy transformation due to nonadiabatic inhomogeneities is studied. It is shown that diffuse mode merging due to large-scale inhomogeneities in ionospheric channels may become quite considerable in long-range and round-the-world propagation. The author thanks A. V. Gurevich and Yu. A. Kravtsov for constructive criticism. References: 9 Russian.

[103-6610]

ON THE PROBLEM OF MODE SEPARATION BY THE METHOD OF DOPPLER FILTRATION

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 23, No 10, 1980 pp 1158-1162 manuscript received 25 Dec 79

BOCHAROV, V. I., DEORDIYEV, A. A., KARYAKIN, N. I., MAL'SHAKOV, V. N. and RUBTSOV, L. N., Institute of Terrestrial Magnetism, the Ionosphere and Propagation of Radio Waves, USSR Academy of Sciences

[Abstract] Propagation of radio waves in the decameter band results in a multi-mode structure due to the many possible trajectories of propagation, leading to interference, waveshape distortion and other interfering effects. These disadvantages are overcome in a system that uses a single-mode channel based on mode separation. The authors give the results of experiments done on 6 and 8 February 1978 on simultaneous mode separation by time selection and Doppler filtration. Transmissions were from Dushanbe to Nikolayev on 20 MHz in the pulse mode. Pulse duration was 0.5 ms, power was 100 kW, recurrence rate was 50 Hz. Reception, registration and processing were done in Nikolayev, 3000 km away. Analysis shows that it is not always possible to separate modes by the Doppler frequencies, even

when they can be separated by time of propagation. However, coincidence of Doppler frequencies for different modes may be an indicator of spatial homogeneity of the ionosphere in the region responsible for mode formation. For proper interpretation of results observed when a narrow-band signal is processed by Doppler filtration, it would be extremely desirable to be able to use a system that permits time selection of modes in doubtful cases. The authors thank E. A. Yagzhova for calculating probable modes of propagation. Figures 3; references: 5 Russian. [103-6610]

UDC 621.371:621.391.82

ESTIMATE OF THE PARAMETERS OF DISTRIBUTION OF INTENSITY OF BURSTS OF ATMOSPHERIC RADIO INTERFERENCE AT VERY LOW FREQUENCIES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2557-2565
manuscript received 8 May 79

DOBRYAK, D. S., PETROVA, L. A. and ELBAKIDZE, A. V.

[Abstract] Radio interference in the VLF (3-30 kHz) band is defined by a fluctuating random process plus a flow of random pulses called atmospherics, which are caused by bolts of lightning. A study is made of the relationship between the distribution of amplitudes of atmospherics at the source (thunderstorm) and the territorial distribution of the sources and the intensity of the sequence of atmospherics at a reception site exceeding a certain predetermined level related to the threshold sensitivity of the receiver. The details of the structure of the sequence of atmospherics are not analyzed. Cloud-to-cloud and cloud-to-ground lightning strokes are analyzed separately, since the bursts generated by these two types of lightning strokes have different statistical properties. The distribution of the mean number of days with thunderstorm activity over the surface of the earth is presented for northern hemisphere summer, as well as curves of the daily variation in intensity of lightning strokes as a function of local time for the various regions of relative thunderstorm activity. The table and curves allow estimates to be obtained of the distribution of the intensity of the sequence of bursts of atmospherics in the VLF band for any reception point on the surface of the earth. The results of these calculations are compared with experimental results. The authors thank L. T. Remizov for participation in a discussion of the results of the work, as well as T. V. Ryabov, M. A. Vasil'yev and T. N. Bulgekov for participation in formulation of the paper. Figures 4; references 11: 7 Russian, 4 Western. [142-6508]

EXACT SPECTRAL-CORRELATION ANALYSIS OF TRANSMISSION OF A RANDOM TELEGRAPH SIGNAL
THROUGH AN AMPLIFIER WITH AGC

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2371-2379
manuscript received 24 May 78, after revision 20 Nov 79

DUBKOV, A. A. and MAL'TSEV, A. A.

[Abstract] The approximate methods that are generally used for analyzing the passage of random processes through systems with automatic gain control are restricted to cases of fairly rapid signals that are not too strong, or instantaneous AGC, or weakly modulated signals. In this paper the authors analyze operation of an amplifier with AGC acted upon by a random signal with a telegraph law of amplitude modulation. Exact expressions are found for the spectral-correlation characteristics of gain of the system and the output signal without the usual limitations on the power and correlation time of the input signal or on the time constant of the integrating filter in the feedback circuit. The analysis is based on the generating function of the telegraph process derived in a previous study [see A. A. Dubkov, A. A. Mal'tsev, "IZVESTIYA VYSSHikh UCHEBnykh ZAVEDENIY: RADIOFIZIKA, Vol 22, No 1, 1979, p 107]. Figures 4; references: 7 Russian. [105-6610]

SOME PARTICULARS OF TRANSMISSION OF A NOISE SIGNAL THROUGH A PARAMETRIC SYSTEM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2309-2313
manuscript received 24 Sep 79

YEGORYCHEV, V. P., KOBIN, M. M., KUZ'MIN, V. G. and ORLOV, I. Ya.

[Abstract] An experimental study is done on the influence that the working conditions of a semiconductor parametric amplifier have on the statistical characteristics of a received noise signal with normal distribution of fluctuations. The measurements were made with a highly stable radiometer developed at the Scientific Research Institute of Radio Physics in Gor'kiy. The noise signal was produced by matched blackbody loads with temperatures of 77 and 300 K and by a white noise generator with normal fluctuation distribution function based on a gas-discharge tube. The parametric amplifier was of degenerate type in the 3-cm band with a GaAs parametric diode. The variable parameter in the amplifier was the initial working point bias voltage. It is found that there are certain working conditions that strongly distort the distribution function of the random process at the output of the parametric amplifier. Specifically, in the absence of currents when the intrinsic noise of the diode is low, there may be operating conditions with considerable distortion of the distribution function of low-frequency fluctuations of the weak noise signal. When currents are flowing through the parametric diode, the distribution function may be distorted by the interaction of strong noise emission with the pump voltage across the nonlinear

conductance of the parametric diode. It is recommended that when making precision measurements of noise signals, a preliminary analysis should be made of the distortions of statistical characteristics of the noise test signal to get required information on fine nonlinear effects in the receiver. The working conditions of the receiver and the parametric amplifier should be simultaneously optimized to minimize the distortion of the distribution function of fluctuations of the test noise signal at the output of the reception channel. Figures 4; references: 4 Russian.
[105-6610]

UDC 621.391

COMBINED OPTIMAL PROCESSING OF TWO CONTINUOUS SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2575-2584
manuscript received 5 Jul 79

YARKYKOV, M. S. and MIKHAYLOV, Ye. A.

[Abstract] The method of Markov's theory of optimal nonlinear filtration in the gaussian approximation is used to solve the problem of synthesis of a device for reception and simultaneous process of continuous signals forming a vector function. It is assumed that the observation contains two components. The useful signal in one component is a narrow-band radio signal with unknown frequency, while the useful signal in the other component is a low-frequency random process. It is assumed that both the radio signal and the low-frequency process contain the same information parameters, which are to be estimated. The values of mean square filtration error produced by digital computer processing allow quantitative estimation of the accuracy of such complex devices for optimal processing and determination of the gain due to combining of the devices. Figures 7; references 6: 5 Russian, 1 Western.
[142-6508]

UDC 621.391

OPTIMIZATION OF DATA TRANSMISSION SYSTEMS WITH RESPECT TO A SET OF TECHNICAL-ECONOMIC INDICES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 23, No 12, Dec 80 pp 59-65

GUBONIN, N. S. and TEL'GAYEV, V. Yu.

[Abstract] Previous literature contains information on optimization of data transmission systems with costs taken into account, and an original approach to an evaluation of the potential cost of information radio lines. Although these

works are important, it should be noted that their overall feature is optimization with respect to a conditional preference criterion, while at previous stages of planning it is desirable to conduct optimization with respect to a nonconditional preference criterion on the basis of a set of quality indices, including economic (costs) and technical: the speed of data transmission, reliability, noise immunity with respect to one or another noise and so on, i.e., to seek a set of nonworst systems with respect to these indices. By finding the connection between values of the quality indices, corresponding to a set of nonworst systems, the so-called equation of optimum surface and the values of the optimum technical parameters of a data transmission system, it is possible to make an evaluation of the limit of the attainable values of the selected quality indices, taking into account their interrelationship at a previous stages of planning. Moreover, it is possible to use the equation of optimum surface as a component of the model of a communication network (e.g., a satellite communication network), making it possible to optimize a higher level system with respect to a set of technical-economic indices with acceptable costs of machine time. Data are presented concerned with propagation on simplex data transmission systems with and without redundancy, duplex systems composed of two independent simplex systems of data transmissions, and cosmic radio communication lines. Figures 2; references 5: 3 Russian, 2 Western (1 in translation).

[150-6415]

UDC 621.391.2

THE APPLICATION OF THEORETICAL NUMERICAL TRANSFORMS TO SIGNAL SYNCHRONIZATION AND DECODING

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1468-1476
manuscript received 18 Jan 79

LOSEV, V. V.

[Abstract] The problem of determining the phase of a periodically repeating sequence, i.e., that of signal search and synchronization with respect to delay, is solved for the case where the input signal is a train of numbers in some system of numeration which are computer processed in order to establish synchronization. Since the synchronization time is governed by the number of elementary operations which must be performed in the signal processing, minimization of the synchronization time reduced to minimization of the total volume of computations. While for a signal sequence of N symbols, both a multichannel correlator and a matched filter require a number of operations which is proportional to $2N^2$, the possibilities of reducing this value are much greater in the latter. This is a consequence of a convolution theorem which states that the convolution of two sequences is equal to the inverse Fourier transform of the product of the spectra of these sequences. Of the two transforms for which the cyclical convolution theorem is true, the classical Fourier transform and transformation in a ring of modulo M integers, the best solution must be based on the latter, since the Fourier requires working with complex numbers and produces rounding-off noise in the counting

process. A technique is proposed for signal synchronization and decoding which is based on the computation of a double Fourier transform in a module M integer ring. The values of N for the best binary sync signals are given in a long table: quadratic residue codes, M -sequences, Zinger codes, Jacobi codes, Hadamard and characteristic codes. The table makes it possible to compare the efficiency of the proposed theoretical numerical transform: it lists the above types of codes, the length of a sequence (from $N = 1$ to 500), the transform length and the modulus. The discussion of code classes and necessary conditions for detection and synchronization is supplemented with two examples: 1) The processing of a quadratic residue code with a length of $N = 271$ in the case of seven level quantization of the input signal; and 2) The synchronization of a characteristic (or Zinger) code with a length of $N = 364$ with seven level quantization of the input signal. The theoretical numerical transforms considered in this paper can be especially effective in combined systems where the same channel is used for the transmission of the sync signal (or the range finding code) and the data transmission signals. Tables 2: references 10: 7 Russian, 3 Western (1 in translation).

[317-8225]

UDC 621.391.2

CONCERNING THE QUESTION OF EQUIVALENCE OF INFORMATION MODELS TO ACTUAL SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2462-2464
manuscript received 15 Mar 79

IVANOV, P. P.

[Abstract] The author discusses some original Soviet papers on information theory and points out that all the authors take continuity of the signal spectrum as a basic tenet. He then considers the kind of spectrum that actual signals may have as exemplified by acoustic signals, and comes to the conclusion that the model of a signal with continuous spectrum, whether finite or infinite, is inapplicable in most practical cases. References: 6 Russian.
[105-6610]

UDC 621.391.2

OPTIMUM FILTRATION OF A GAUSSIAN PROCESS AGAINST A BACKGROUND OF INTERFERENCE CORRELATED WITH THIS PROCESS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2314-2341
manuscript received 2 Jan 79

KUL'MAN, N. K.

[Abstract] The author considers the problem of designing optimum and near-optimum filters for processing experimental data, construction of information measurement systems and other applied problems of information theory. An important aspect of

this problem is proper selection of the model of the observed signal. This question is examined with consideration of mutual correlation of the information process and noise, as well as delay in getting an estimate of the process. Specifically, a solution is found for the problem of instantaneous filtration and interpolation of a gaussian Markov message in the case of reception against a background of white noise and gaussian Markov interference correlated with the message. Expressions are derived for the variances of errors of filtration and interpolation, and conditions are found that enable conversion from the general model containing both correlated and uncorrelated interference to simpler models containing either only uncorrelated interference or only correlated interference. In such cases, the equations for optimum filtration can be replaced by simpler expressions without noticeable loss of filtration quality. References: 11 Russian. [105-6610]

UDC 621.391.2

DEPENDENCE OF VALUES OF THE AUTOCORRELATION FUNCTION ON THE BLOCK STRUCTURE OF A CODE SEQUENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2314-2322
manuscript received 5 Apr 77, after revision 21 Jun 79

MUKHAMEDYAROV, R. D. and MITSEL'MAGER, E. Ye.

[Abstract] The authors consider the problem of synthesizing binary code sequences that have optimum autocorrelation properties. Necessary conditions are found for optimality of binary phase-keyed and amplitude-keyed signals with respect to a minimax criterion. These conditions impose a number of constraints on the block structure of a code sequence to keep the side peaks of the autocorrelation function below a predetermined level. A block in this sense is the maximum sequence of identical elements in succession. Asymptotic estimates and computer calculations show that the use of three necessary conditions considerably narrows the area of search for optimum signals, and appreciably reduces the variance of the autocorrelation function of the signals. The results are applied to optimization of the autocorrelation function structure of some signals. Tables 2; references: 10 Russian. [105-6610]

UDC 621.391.2

DETERMINATION OF PROBABILITY CHARACTERISTICS FOR TRAINING ALGORITHMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKTONIKA in Russian Vol 23, No 12, Dec 80 pp 77-78 manuscript received 10 Jul 79, after completion 2 Jan 80

RUCH'YEV, M. K.

[Abstract] The solution to the problem of discrimination of signals distorted by interference, in conditions where only a graded training sequence is given, leads to training algorithms. If the probability characteristics of training algorithms are set up in the process of training, then it is possible to stop training at that moment when these characteristics correspond to those required. Then for algorithms, inclusion of additional information will not be necessary. Rules making it possible to determine the moment of discontinuation of training are presented in 1970 and 1974 works from the literature. In contrast to these rules the procedures proposed in the present short communication assumes a limited number of corrections of the algorithm, which makes it possible more precisely to determine this moment. The proposed algorithm determines more precisely the lower boundary of the number of accurate solutions adopted in succession, whereby the agreement of the total probability characteristics of the specified training algorithm is verified. Tables 1: references: 2 Russian.

[150-6415]

UDC 621.391.8

INVESTIGATION OF THE GENERALIZED PROBABILITY DISTRIBUTION OF RADIO SIGNAL POWER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2329-2333
manuscript received 29 Jun 79

GORKIN, Yu. S. and RADZYEVSKIY, V. G.

[Abstract] Probabilistic models of radio signal amplitude can describe a variety of statistical data. A concept of particular importance in this regard is the generalized distribution, i.e. the probability distribution of the absolute value of a two-dimensional vector with gaussian distribution of orthogonal projections that are correlated with each other and have different mathematical expectations and variances. In this paper expressions are found for coefficients of variation, skewness and kurtosis of the generalized probability distribution of radio signal power. Estimates are found for the capabilities of generalized probability distributions of amplitude and power for describing statistical data. Distributions of this type are approximated by using distributions of simpler form. Figures 3, references 9: 6 Russian, 3 Western (2 in translation).

[105-6610]

UDC 621.391.14:519.2

DISCRIMINATION OF SIGNALS BY THE POWER SPECTRUM IN THE KARUNAN-LOEV BASIS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNIKA in Russian Vol 23, No 12, Dec 80 pp 11-17 manuscript received 23 Jul 79, after revision 14 May 80

OMEL'CHENKO, V. A.

[Abstract] The paper considers discrimination of useful signals with interference in conditions of specified a priori indeterminacy. It is shown that with the proposed method, discrimination of signals in increased a priori indeterminacy, when the signals presented are divided into two classes -- useful and interference, the useful signals are assigned a training graded sampling, and with respect to the interference signals only some qualitative information is known. It is sound practice to identify useful signals with interference in the conditions of unequal a priori indeterminacy concerning them, by the power spectrum at an optimum basis, when the useful and interference signals differ by the second moments of a distribution. It is also sound practice to determine the membership of a signal to the useful or interference class by its location relative to the characteristic region of useful signals. Discrimination depends on the useful signals falling in this region. Experimental studies conducted on pseudorandom signals show that a sufficiently good quality of separation of the class of useful signals and their subsequent discrimination by evaluation of the power spectrum is already assured with a small number of informative characteristics and small values of the smoothing factor. It is possible to improve this quality by increasing the smoothing factor. Tables 1; references 8: 7 Russian, 1 Western in translation.

[150-6415]

UDC 621.391.26

RANK BINARY DETECTION OF A DETERMINATE SIGNAL AGAINST A BACKGROUND OF MARKOV INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1454-1459 manuscript received 15 Mar 79

AKIMOV, P. S., KURASOV, A. N. and LITNOVSKIY, V. Ya.

[Abstract] A binary rank Neumann-Pearson detector operates in the presence of correlated interference. The detector makes observations which are the basis for decision making concerning the presence or absence of a useful signal in the sample being studied. In each i-th observation, the value of the rank is computed, which is defined by the number of times the readout being observed in the tested channel exceeds the readouts of the interference sample which is extracted from a certain number of channels adjacent to the tested channel. The rank characterizes the 'contrast' (where there is a contrast) between the values of the signal and

the interference. The values of the ranks are then subjected to binary quantization and, based on a sequence of zeros and ones (the results of quantizing a number of observations), a decision is made concerning signal presence in the tested channel. The detector design is substantially simplified with this binary quantization of the ranks and its efficiency is close to the efficiency of a detector based on a sum of the ranks. Adjustment of the threshold is proposed in order to assure a constant false alarm probability, and the derived expressions for the distributions of the statistics in the test hypotheses make it possible to evaluate the quality of the procedure. A block diagram of a proposed adaptive multichannel detector is shown, although the majority theoretical analysis in the paper gives no indication of any experimental check; there are computed curves for the detection threshold as a function of the detection probability and the signal-to-noise ratio. Figures 3; references: 6 Russian.
[317-8225]

UDC 621.391.82.029.4

THE INTERRELATIONSHIP BETWEEN THE INTENSITIES OF THE FLUCTUATING AND PULSED COMPONENTS OF ATMOSPHERIC RADIO INTERFERENCE IN THE VLF BAND

MOSCOW RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, July 80 pp 1414-1419
manuscript received 28 Feb 79

REMIZOV, L. T.

[Abstract] Experimental data from 1972-3 show a clear correlation between the diurnal changes in the standard deviation of the intensity of the fluctuating component of atmospheric radio interference and the intensity of the pulse component in a frequency range of 1 to 18 kHz. Other data for the VLF band (3 - 30 kHz) show a similar correspondence. This paper employs a wideband model of such radio interference which is defined as a statistically random process consisting of weak pulse emissions mutually overlapping in time, in order to ascertain the quantitative relationship between these VLF interference components from known measurable parameters. The derived formula for the intensity of the fluctuating component of this atmospheric noise is written as an exponential function of the pulsed component intensity, which makes it possible to obtain estimates in agreement with independent experimental data. The calculated and experimental figures cited substantiate the radiophysical model used for the fluctuating component: this component is a set of low intensity atmospherics which overlap in time with a slight fluctuation in their peak values. The author thanks Yu. V. Kobzarev for discussion of the work, as well as I. G. Vyskrebtsov and A. N. Korolev for participation in obtaining the experimental data presented, and I. V. Oleynikov for participating in processing of the experimental data.
Figures 3; references 9: 8 Russian, 1 Western.
[317-8225]

A METHOD OF EVALUATING THE APPLICABILITY OF MODELS OF ATMOSPHERIC RADIO INTERFERENCE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1420-1425
manuscript received 21 Mar 79

BASALAYEV, N. L.

[Abstract] Expressions are adduced for the integral probability distribution functions of the envelope of atmospheric radio interference for various mathematical models of the interference. These functions for the interference envelope are defined as the probabilities that an envelope will exceed a set level. The probability functions are the criteria for the choice of the most acceptable model and the basis for their comparison with experimental data on atmospheric interference generalized in CCIR Report No 322. Four models are studied: 1) A log normal interference distribution; 2) The Hall or "t" model; 3) A model using a linear combination of Rayleigh distributions; and 4) An empirical exponential law for the interference distribution function. The integral distributions are derived in all four cases and the range of applicability of the various models is assessed; it is noted that the Hall model is the most universal and has the greatest dynamic range, being applicable to the shortwave, medium and long wave bands. Figures 2; references 8: 5 Russian, 3 Western.
[317-8225]

ANALYSIS OF INFLUENCE OF HARMONIC INTERFERENCE AUTOCOMPENSATOR ON PULSE RADIO SIGNALS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 23, No 12, Dec 80 pp 66-67 manuscript received 31 Jan 79, after revision 12 Mar 80

CHURKIN, V. V.

[Abstract] In the case of maximum distortion of radio pulses in auto-compensators which occur in a regime of suppression of harmonic interference, methods for investigation of the influence of linear and nonlinear systems of automatic control of the amplitude of an oscillator (ACO) on radio pulses, and a modelling algorithm for passing radio pulses through nonlinear systems of ACO are presented. The investigations conducted make it possible to draw the following general conclusions: 1) Autocompensators with nonlinear systems of ACO introduce less distortion in intensive radio pulses and an excitation response of smaller amplitude and duration than is the case with linear systems; 2) Radio pulses for which $U_c(t) < a$ are completely suppressed by nonlinear systems; and 3) In the operating range of autocompensators with linear systems of ACO it is necessary to fulfill the relation of $\ll U_t / \gamma_f$, where γ_f is the duration of the leading edge of a signal radio pulse. Figures 2; references 6: 5 Russian, 1 Western.
[150-6415]

UDC 621.396.9

SEARCH FOR TWO-DIMENSIONAL VECTOR PARAMETER OF RADIO SIGNAL

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKTONIKA in Russian Vol 23, No 12, Dec 80 pp 43-46 manuscript received 16 Jul 79

BRANDIN, V. K. and SUDAKOV, V. F.

[Abstract] The paper is concerned with the problem of optimizing the strategy of search for the two-dimensional vector parameter of a radio signal. This reduces to a determination of the principle of movement of the center of distribution of the power density of the search effort with respect to a known trajectory. An expression for the optimum speed of movement is obtained for a sufficiently characteristic case. The results obtained make it possible to organize in an optimum manner the procedure for search of the parameters of a radio signal.

References 4: 3 Russian, 1 Western.

[150-6415]

UDC 621.396.23

CONTINUOUS CONTROL OF THE RATE OF DATA TRANSMISSION IN RADIO LINKS WITH SIGNAL FADING

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKTONIKA in Russian Vol 23, No 12, Dec 80 pp 78-80 manuscript received 24 Jul 79, after revision 2 Jan 80

PAKHOMOV, I. S. and POSTYUSHKOV, V. P.

[Abstract] During operation of a radio line with a fixed speed of a source of communications under conditions of signal fading, the transmitter power is selected so as to assure requirements with respect to the reliability of data transmission with a given dependability. In so doing, during a large part of the time the energy potential of the radio line considerably exceeds the amount necessary to assure a given reliability. The excess power can be used for an increase of transmission speed of the communications and consequently also the transmission capacity of the radio line. This statement of the problem was solved in a 1976 book edited by Z. M. Kanevskiy, which proposes to reduce somewhat the speed of transmission. The control algorithm, however, which assures functioning of the radio line without loss of the reliability of communications, and an evaluation of its effectiveness in the indicated operation are not given. The present short communication solves the problem of control of the transmission speed without loss of reliability and its effectiveness is evaluated. It is shown that control of data transmission in a real radio line is found to be effective only in the case of high precision of evaluation of the state of the channel. Figures 2; references: 2 Russian.

[150-6415]

ON TWO-STAGE SIGNAL SEARCH IN A MULTICHANNEL SYSTEM TAKING INTO ACCOUNT POSSIBLE SHIFTING OF THE SIGNAL FROM CHANNEL TO CHANNEL

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1438-1444
manuscript received 25 Apr 77

SHAPIRO, F. A.

[Abstract] A signal search algorithm is proposed which takes into account possible shifts of the signal from one channel to another during the time which elapses between the preliminary and final inspection of the channels. Two stages are involved: 1) In the first, each channel is inspected for a certain time, sequentially one after the other. The log of likelihood ratio is computed in each channel and then stored. The measured values of this logarithm are recomputed after the preliminary inspection of all the channels. All channels are ordered in decreasing value of the recomputed log of the likelihood ratio and these ordering values are stored. 2) In the second stage, the channels are reviewed in order of increasing value; a sequential analysis procedure is used with fixed false alarm and signal detection error probabilities. To accelerate the search, data are used in the second stage which are accumulated during the preliminary inspection: the final review begins either with the value of the above logarithm accumulated at this point in time or with its recomputed value. This paper analyzes the case where there is a probability of $1-p$ that the signal will remain in the same channel during the time between the preliminary and final inspections, there is the probability of $p/2$ that it will shift to the adjacent channel to the left and a probability of $p/2$ that it will shift to the right channel. An analytical expression is found for the mean time required to find the signal channel and the search time is then optimized. Accounting for the shifting of the signal among the channels reduced the mean time needed to find the signal channel by a factor of 1.38 to 1.58 times the value for a previous algorithm in Soviet literature which did not take this possible signal shifting into account. The author is grateful to A. F. Terpugov for discussing the statement of the problem and for helpful comments. Figures 3; references 17: 16 Russian, 1 Western.
[317-8225]

INTERFERENCE IMMUNITY OF A NOISE SIGNAL RECEIVER OPERATING BY THE METHOD OF BILATERAL SPACE CONTRAST IN THE PRESENCE OF LUMPED INTERFERENCES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 23, No 11, Nov 80 pp 78-80 manuscript received 27 Apr 79, after revision 5 Dec 79

KUDINOV, A. V. and TERESHCHUK, R. M.

[Abstract] A receiver of noise signals operating with bilateral contrast in the mean is considered which consists of a band filter, a detector, an integrating low-pass filter, two delay lines, an adder, a voltage divider, a subtractor, and

a zero-threshold device. Its interference immunity in a field of anisotropic distributed and several lumped interferences is calculated, assuming that the receiver has ideal components and a directional antenna. The interference immunity either hardly changes or decreases, largely depending on the angle at which a lumped interference arrives relative to the direction of the signal source and the orientation of the receiver antenna. Decreasing the time delays will improve the angular resolution and narrow down the main lobe of the radiation pattern, while decreasing the voltage divider ratio will then reduce the now higher false-alarm probability to its acceptable level. However, the resulting appearance of additional side lobes makes calculation of the interference immunity by this method less accurate. Figures 3; references: 1 Russian.
[117-2415]

UDC 621.396.677.85

FREQUENCY PROPERTIES OF ZONED FRESNEL LENSES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2491-2497
manuscript received 15 Oct 79

BAZARSKIY, O. V., KOLESNIKOV, A. I. and KHLYAVICH, Ya. L.

[Abstract] Zoned Fresnel lenses are coherent focusing devices based on coherent addition of radiation from a number of spatially distributed zones. The simplest device of this type is a zoned Fresnel plate, a hologram of a point light source. Phased zoned Fresnel plates, in which the nontransparent portions are replaced with a dielectric which changes the phase of the incident wave by π , double the diffraction efficiency: a further improvement is the half-tone phased zoned Fresnel plate: an equation is presented for calculation of the radii of the zones of such a plate. The frequency properties of these and other zoned Fresnel lenses are analyzed. The conditions under which zoned Fresnel lenses can be considered paraxial are determined, and the relative error which results when zones are calculated in the paraxial approximation is calculated. The frequency range within which zoned Fresnel lenses can operate is limited only by the aberrations which occur when the focal length is greatly reduced due to alteration of the frequency of radiation. In the paraxial approximation the pulsed response to the spectrum formed by zoned Fresnel lenses is independent of frequency, moving only in space due to a change in focal length. This makes the devices quite promising for three-dimensional processing of frequency modulated signals. Nonparaxial zoned Fresnel lenses have significantly less bandwidth but provide the necessary frequency deviation without significant deterioration of parameters. Figures 7; references 10: 7 Russian, 3 Western in translation.
[142-6508]

UDC 681.31:32

DETERMINATION OF THE PHASE OF A PSEUDORANDOM SEQUENCE

Kiev IZVESTIYA VYSSHIKH UCHEbNYKH ZAVEDENIY: RADIODEKTRONIKA in Russian Vol 23, No 12, Dec 80 pp 81-82 manuscript received 5 Jul 79, after revision 15 Jan 80

LOSEV, V. V.

[Abstract] The problem arises in various applications of determining the phase of a periodically recurrent sequence by its distorted segment. In discrete channels it is possible to use algebraic methods of decoding in order to solve this problem. In a gaussian channel the optimum procedure for processing is by the method of maximum probability. Realization of the optimum procedure requires large computing expenditures. The present short communication describes an optimum processing algorithm which makes it possible substantially to decrease the amount of computations. References: 4 Russian.
[150-6415]

UDC 681.325.5

UPPER BOUND OF COMPLEXITY IN MULTIPLYING A VECTOR BY A BINARY MATRIX

Moscow RADIOTEKHNika I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2464-2467
manuscript received 17 Sep 79

LOSEV, V. V.

[Abstract] The author considers the use of fast transform methods for reducing the complexity of multiplying a vector by a matrix. Processing of binary signals amounts to multiplying a vector by a binary matrix with elements 1 and -1. It is shown that for binary matrices the bound of complexity of calculations can be considerably reduced, and for square matrices of dimensionality from 2^4 to 2^{16} , the necessary number of operations can be reduced by a factor of 2-10. The special algorithm that is used to accomplish this simplification includes the Walsh-Hadamard fast transform as a special case. References: 4 Russian.
[105-6610]

COMPONENTS AND CIRCUIT ELEMENTS,
WAVEGUIDES, CAVITY RESONATORS AND FILTERS

UDC 621.37/39:534

THE TEMPERATURE DEPENDENCE OF THE POSITION OF A COMPRESSED LINEAR FM SIGNAL IN
SURFACE ACOUSTIC WAVE DISPERSION DELAY LINES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1504-1507
manuscript received 1 Nov 78

BRITSYN, K. I., AKPAMBETOV, V. B., VORONKOV, B. I. and CHERNOV, O. V.

[Abstract] The use of surface acoustic wave devices in the processing of a linear FM signal must take into account the temperature dependence of the SAW velocity and piezoelectric substrate length. This makes the center frequency of a linear frequency modulation signal and its time position a function of temperature; a result of the latter is an error in the determination of the target coordinates. The impact of thermal factors on the time position of a compressed LFM signal in dispersion delay lines is studied theoretically. A procedure for the calculation of the temperature coefficient of delay of such signals is described, and the calculated and experimental results are compared. Recommendations are given for the minimization of the temperature deviations in the time position of such compressed signals. Analytical expressions are derived and plotted graphically to show the change in the absolute delay time of a compressed LFM signal in a temperature range of -80 and +80°C for three cases of the operation of SAW shaping and compression devices for LFM signals: 1) The signal processor (compressor) and the signal generator operate under identical temperature conditions; 2) The compressor operates at a stable temperature; and 3) The signal generator operates at a stable temperature. The proposed technique makes it possible to predict the behavior of such a compressed signal in a specific temperature range. Figures 1; references: 3 Russian.

[317-8225]

UDC 621.372:8

A DIELECTRIC STRIPLINE WAVEGUIDE FOR THE SHORTWAVE PORTION OF THE MILLIMETER BAND

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1348-1351
manuscript received 26 Mar 79

VERSHININA, L. N. and MERIAKRI, V. V.

[Abstract] Dielectric strip waveguides take the form of a rectangular cross-sectional strip placed on a dielectric substrate or embedded in it. The strip dimensions can vary in a wide range while retaining single mode propagation with the appropriate choice of the ratio of the indices of refraction of the strip and the substrate. Three cross-sectional configurations of dielectric strip waveguides are analyzed: 1) With the strip embedded in the dielectric; 2) With the strip on the surface of the dielectric; and 3) With the strip sandwiched between the dielectric layers. The waveguide strip and substrate were fabricated

from poorly absorbing porous fluorolons and fire resistant ceramics: the index of refraction of the strip for the former was 1.30 with an attenuation of 0.18 dB/cm, where the bar had a cross-section of $1.8 \times 3.4 \text{ mm}^2$. The substrate index of refraction was 1.24 with an attenuation of 0.18 dB/cm. In the ceramic waveguide, the index of refraction was 1.826 with attenuations of 0.38 dB/cm for both the strip and the substrate where the substrate had an index of refraction of 1.735; the cross-section of the strip was $2 \times 4 \text{ mm}^2$. All measurements were made at a wavelength of 1.67 mm. Analytical expressions were derived for the transmission efficiency of such waveguides. The per unit length losses were measured using several waveguide sections; these losses and the excitation losses were 0.15 to 0.3 dB/cm and 0.9 dB respectively. The distribution of the field intensity of the E_{11}^x and E_{11}^y modes (the coordinate system has the origin in the center of the strip with the y axis vertical up through the strip and substrate and the x axis running laterally out through the side of the strip) are shown graphically and found to agree with the calculated values in directions which do not intersect the boundary of the strip and the substrate, though they otherwise differ considerably from the calculated values of Marcatili [BELL SYSTEM TECH. JOURNAL, 1969, No 7, p 2071]. A bend exhibits poor efficiency in such waveguides; it can be replaced by a corner in most cases and the losses still held to tenths of a dB. The authors thank A. M. Markevich and N. A. Kleymenov for presenting porous fluorolons and V. V. Dem'yanov for presenting waveguides of quartz ceramics. Figures 3; references 10: 6 Russian, 4 Western.

[317-8225]

UDC 621.372.413:621.318.134.029.64

A RESONATOR USING SURFACE SPIN WAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1376-1383
manuscript received 28 May 79

VUGAL'TER, G. A.

[Abstract] A meander of a conducting material can be applied to the surface of a single crystal ferrite in order to excite surface spin exchange free waves in 'thick' samples. This paper theoretically studies the impedance of such meander type strip line converter which produces surface spin waves in an iron-Yttrium-garnet film. The following model is assumed: a ferrite is placed in a magnetic field parallel to its surface and the meander strip is applied to this surface. The dimension of the meander in the direction of this magnetic field is larger than the characteristic surface wavelength and the dependence of the fields on this coordinate can be neglected. Partial differential equations are solved for the induced fields using Fourier transforms in order to find the resonant frequency and Q of a resonator designed around such a converter. An analytical expression is found for the inductance of the converter at a specified frequency and estimates are given for an IYG sample showing that the resonator Q is on the order of 1,000 at a frequency of 10 GHz. In the case of an aluminum meander with a thickness equal to the skin layer thickness of about 8 micrometers, the ohmic resistance is about 20 ohms and the contribution of ohmic losses is insignificant. No experimental check of the derived expressions is indicated in the paper. Figures 2; references 7: 3 Russian, 4 Western (1 in translation).

[317-8225]

UDC 621.372.413:621.372.8

THE DESIGN OF A RESONATOR FOR A RADIOSPECTROSCOPE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1370-1375
manuscript received 8 Feb 79

BELOV, Yu. G. and RAYEVSKIY, S. B.

[Abstract] A rectangular waveguide resonator having circular holes in the walls in which an ampoule with a substance to be studied is inserted is employed as the absorption cell in electron paramagnetic resonance radiospectroscopes. This paper develops a computational technique in order to determine the resonant frequencies, field structure and Q of such resonators, where the ampoule is considered to be a thin walled circular dielectric cylinder having the dielectric permittivity of the material filling the ampoule. In deriving the characteristic equation describing the behavior of the resonator, a sectional approach is used which breaks the entire volume down into four regions where regions one and four form the portion of the resonant volume free of the dielectric, region two is the portion of the dielectric cylinder enclosed between the walls of the resonator and the third region is the portions of the dielectric cylinder falling outside the waveguide channels. The resulting analytical expressions are graphed, with the resonance wavelength and longitudinal wave number plotted as a function of the dielectric cylinder radius and its relative dielectric permittivity. The theoretical calculation of the resonant wavelength differs from the actual working wavelength of a real spectrometer by a maximum of 2.5% for the first approximation and less than 1% for the second approximation; the measurement error did not exceed 0.1%. The calculation of the Q for various values of the conductivity of the metal of the walls and the tangent of the dielectric loss angle is shown in tabular form for polished copper and mechanically polished silver when testing benzene and acetone. The calculated Q's are 6,000 to 8,000 depending on the solvent and the measured values are close to those calculated, though are somewhat lower because of the finite Q of the coupling and tuning elements. The authors thank S. N. Arzhanov and A. V. Kukushkin for assistance in making the numerical calculations. Figures 5; references 5: 3 Russian, 2 Western (1 in translation).

[317-8225]

UDC 621.391.2

AN ADAPTIVE DIGITAL REJECTION COMB-FILTER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 23, No 11, Nov 80 pp 75-78 manuscript received 23 Apr 79, after revision 2 Aug 79

KUZ'MINSKIY, A. M.

[Abstract] A recursive adaptive digital rejection filter is synthesized for suppression of quasi-periodic interference additively mixed with a wideband useful signal. Both signal and interference are assumed to be stationary in the broad

sense, with zero mean values, but their statistical characteristics to be unknown. A comb structure is considered with the transfer function $H_C(z) = (1-b)/(1-bz^{-m})$ and the difference equation $y_n = (1-b)x_n + by_{n-m}$, $0 \leq b \leq 1$ determining the quality of its amplitude-frequency characteristic. The rms error can be minimized by multiplying the comparator output signal by a factor c . The optimum factor c_0 is related to the signal parameters, but cannot be stipulated exactly when the dispersion σ^2 is not a priori known. Here an estimate $c_0 \approx b_0$ is found which does not depend on σ^2 . Using this factor will always reduce the steady rms error, although not quite as much as the true optimum factor. The difference in performance is not appreciable, however, and well offset by the simpler filter structure. Figures 2; references: 2 Russian, [117-2415]

UDC 621.372.852:621.3.029.

A MICROWAVE ATTENUATOR BASED ON TWO LONGITUDINALLY DISTRIBUTED p-i-n STRUCTURES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1529-1531
manuscript received 23 Mar 79

USOV, N. Yu.

[Abstract] Waveguide attenuators based on a longitudinally distributed p-i-n structure can have U- and H-shaped configurations. The structure is usually arranged along the waveguide axis. This short communication treats the possibility of increasing the microwave signal control efficiency by means of using two such longitudinally distributed structures positioned at equal distances from the longitudinal axis of the waveguide. Experimental studies were made using silicon alloy p-i-n structures with an i-region thickness of about 400 micrometers. The change in the signal attenuation in the interaction region of the device is shown as a function of the current density for configurations with one and two p-i-n structures at a frequency of 14 GHz. The two p-i-n structure exhibits considerably greater changes in the attenuation, amounting to nearly 20 dB. At the maximum attenuation, the bandwidth was also adequate. The initial losses in the 12 to 16 GHz range for any of the structures do not exceed 0.3 to 0.4 dB in the interaction region. It is possible to reduce the length of the interaction region and increase the efficiency of microwave signal control without increasing the initial losses. Figures 2; references 7: 6 Russian, 1 Western. [317-8225]

CONVERTERS, INVERTERS, TRANSDUCERS

UDC 621.314.572

HIGH-POWER THYRISTOR ULTRASONIC FREQUENCY CONVERTERS WITH CHOPPING DIODES

Moscow ELEKTRICHESTVO in Russian No 12, Dec 80 pp 31-35 manuscript received 24 Sep 79

KATSNEL'SON, S. M., candidate of technical sciences, and OSNOBKHIN, Yu. V., engineer, Ufa Institute of Aviation

[Abstract] Use of efficient circuit solutions make it possible to avoid the appearance of switching overvoltages and to create large thyristor ultrasonic frequency converters based on thyristors with reduced switching losses, able to operate with an extremely variable load and intermittent regimes with full stabilization of voltage. A new circuit is presented for a high-power thyristor ultrasonic frequency converter with chopping diodes which has the above properties. The basic circuit is shown of a double-section thyristor inverter with chopping diodes. An analysis is made of the electromagnetic processes in the inverter during its operation in a parallel load circuit. The dependence is presented of the maximum currents, voltages, moments of time of connection and disconnection of the chopping diodes on the attenuation of the inverter circuit. Using the circuit considered, based on type TCh thyristors, 22 kHz frequency converters with a power of 50 kW were constructed, which in the course of 3 years were successfully exploited at machine building plants for a number of purposes. Figures 5; references: 2 Russian.
(148-6415)

UDC 621.316.722

TRANSFORMER-THYRISTOR CONTROLLED CONVERTERS FOR A.C. VOLTAGE

Moscow ELEKTRICHESTVO in Russian No 11, Nov 80 pp 30-34 manuscript received 23 Nov 79

SAVIN, A. G., candidate of technical sciences, Kalinin Polytechnical Institute

[Abstract] A method of regulating the a.c. voltage of a converter with little distortion and maximum weight-size economy is described which involves superposing a step voltage on the sinusoidal supply voltage. This step voltage comes from a rectifier connected in series with the a.c. load and across the source of d.c. emf. The principle of this device on a 3-phase bridge configuration is analyzed by replacing it with two model devices: an ideal current converter supplied from a source with an infinitely large impedance and an ideal voltage converter supplied from a source with a zero internal impedance. The system includes also a voltage boosting transformer and a power transformer. The energy transfer from the a.c. side to the d.c. side can be regulated and even reversal from converter operation to inverter operation is possible by regulating the control angle. The theory of operation is further explained with the aid of

phasor diagrams. The performance parameters of this device, namely regulation range and ripple factor, are calculated according to the appropriate GOvernment Standard (13109-67). When there is no energy transfer from the a.c. network to the intermediate d.c. circuit, then the voltage converter can be eliminated and the current converter must operate with a constant 90° control angle. In this case a capacitor is used for regulating the a.c. voltage and no power transformer is needed. Figures 6; references: 9 Russian.
[125-2415]

ELECTRICAL ENGINEERING, EQUIPMENT AND MACHINERY: APPLICATIONS AND THEORY

UDC 621.314.214.2

A PHASE SHIFTER BASED ON A ROTATING SINE-COSINE TRANSFORMER WITH AN RC-CIRCUIT

Moscow ELEKTRICHESTVO in Russian No 11, Nov 80 pp 50-53 manuscript received 5 Feb 80

ARTYUKHOV, Ye. A., candidate of technical sciences, Leningrad

[Abstract] An RC-type phase shifter is described which also includes a single-phase rotating transformer with two secondary windings, namely a sine winding and a cosine winding, wound orthogonally to one another and forming two opposite arms of a bridge. The phase shifting resistor and capacitor form the other two opposite arms of this bridge. For compensation of any orthogonality error as well as errors due to the load and the resistances of both secondary windings, a trimming inductance coil or resistor are added in series with the phase shifting resistor or capacitor respectively. The output voltages and phases are calculated on the basis of the equivalent circuit diagram for this bridge, taking into account the transformer ratio and angle errors as well as any mismatch between the RC-network frequency and the line frequency. The results indicate that the phase shifter is almost immune to variations of the line frequency, of the RC-network parameters, and to instability of initial phase shifts of the transformer output voltages. It is possible to check the phase shifter and then trim it, after assembly, by switching around the two orthogonal primary windings of the transformer and simultaneously inverting one of the output signals. Figures 3; references: 5 Russian.

[125-2415]

UDC 621.315.2.048.001.4

BREAKDOWN CHARACTERISTICS AND ENDURANCE TESTING OF PULSE-DUTY CABLES WITH POLYETHYLENE INSULATION

Moscow ELEKTRICHESTVO in Russian No 11, Nov 80 pp 61-64 manuscript received 21 May 79

LYSAKOVSKIY, G. G. [deceased], candidate of technical sciences, and PIL'SHCHIKOV, V. Ye., engineer, Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] Cables with continuous polyethylene insulation installed in heavy-power electrophysical research equipment must be able to withstand 10^4 - 10^5 voltage pulses repeating at rates up to 1 Hz and producing an electric field intensity of 30-40 kV/mm at the surface of the conductor vein, without causing the probability of breakdown along a 10-30 m cable length to exceed 10^{-2} . Accelerated endurance tests were performed on up to 1.25 m long RK-50-11-13 and AKPVM-1/50, 1/60 cables with burrs and dents intentionally made before insulation.

They were subjected to a.c. voltages at 50 Hz, to d.c. voltages for certain lengths of time, and to voltage pulses repeating at rates of 0.5-1 Hz. These pulses had cosinusoidal leading edges, corresponding to a natural frequency of 20-30 kHz, with a 0.7-1 μ s rise time and a 1.3-1.4 decrement. Assuming the safe probability of breakdown at a certain electric field intensity to have a Weibull distribution with respect to time or number of pulses, and assuming the latter two to be related to the electric field intensity according to an inverse-square law, the purpose of these tests was to establish an experimental procedure and to verify the approximation of the probability of breakdown after initiation of a dendrite as the ratio of safe probability to probability of dendrite initiation. The results indicate that testing the polyethylene insulation for 1 min with a d.c. voltage producing an electric field intensity of approximately 460 kV/mm at the surface of the cable vein will reveal dendrites. The time till complete breakdown at this electric field intensity does not depend on the type of cable. The probability of dendrite initiation has also a Weibull distribution while the probability of complete breakdown after dendrite initiation has a log normal distribution with respect to time. Figures 6; references 13: 9 Russian, 4 Western. [125-2415]

UDC 621.315.615

SELECTING OPTIMUM SHAPES FOR INSULATORS IN HIGH-VOLTAGE IMPULSE DEVICES WITH WATER INSULATION

Moscow ELEKTRICHESTVO in Russian No 12, Dec 80 pp 56-58 manuscript received 5 Dec 78

USHAKOV, V. Ya., doctor of technical sciences, MURATOV, V. M., candidate of technical sciences, LOPATIN, V. V., candidate of physicomathematical sciences, KAPISHNIKOV, N. K., KUKHTA, V. R. and SHEMYAKIN, A. I., engineers, Scientific-Research Institute of High Voltage attached to Tomsk Polytechnical Institute

[Abstract] The object of this paper is to determine the effectiveness of methods for regulation of a field by a choice of the configuration of insulators and electrodes and the material of insulators as a means of increasing the sparkover voltages in water. Sparkover in water with $P = 2$. 10 ohm cm. was investigated for polyethylene, organic glass and caprolon insulators of various shapes in a homogeneous field and in a field of coaxial cylinders. Curves are shown of: 1) Dependence of discharge gradients for the surface of polyethylene and caprolon cylindrical insulators on their length; and 2) Dependence of the sparkover voltage of polyethylene and organic glass insulators on the ratio of insulator diameters with $D = 96$ mm. It is concluded that regulation of a field as a means of increasing the discharge voltages for insulation constructions, as applied to insulators functioning in water, is of low efficiency. Regulation of a field gives rise to the appearance of a component of an electrical field normal to the surface of an insulator, which decreases the sparkover voltage. Consequently, in the majority of cases, the optimum form of insulators is the simplest (cylinder, plane disk, and the like), with the surface of the insulator parallel to the lines of force of the field. The discharge gradients for the surface of the insulators

in water, to a less degree than in gases and nonpolar liquids, depends on the properties of the material of insulators and to a considerable degree are determined by the electric strength of the same water. The choice of material for insulators functioning in water must be determined by mechanical strength, resistance of the surface to the influence of a discharge current, and the electrical strength during a thorough breakdown. Figures 2; tables 2; references: 6 Russian.

[148-6415]

UDC 621.315.623.5.027.3

OPTIMUM SHIELDING OF INSULATOR SUPPORT STRUCTURES FOR ELECTRICAL EQUIPMENT

Moscow ELEKTRICHESTVO in Russian No 11, Nov 80 pp 12-17 manuscript received 30 Mar 79

ALEKSANDROV, G. N., doctor of technical sciences, and SERGEYEV, A. S., candidate of technical sciences, Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] The three reasons for shielding an insulator support structure for high-voltage equipment are to suppress the streamer corona, to ensure a high electrical strength, and to limit the nonuniformity of the voltage distribution. Shields in the form of single and double toroids had been designed on the basis of electric field calculations according to the system of Maxwell equation $\mathcal{A} G = \Phi$ (\mathcal{A} denoting the matrix of potential coefficients, G denoting the matrix of charges, Φ denoting the matrix of toroid potentials) with the aid of the Ollendorf formula for potential coefficients. An experimental study was made in order to determine the effect of these shields on the electrical strength of insulator support structures: 5xAKO-110 tripod on a triangular pedestal, 5xAKO-110 tripod on a $1 \times 5 \text{ m}^2$ large rectangular pedestal, and 5xKO-110, hollow 5xRVMG-110, hollow IShO-500 on $0.2 \times 0.2 \text{ m}^2$ large rectangular pedestals. The pedestal was 2.5 m high in each case and a tube with a radius of 5 cm was used for mounting the toroids, toroids of various outside radii from 0.5 to 1.75 m. Tests were performed with oscillatory voltage pulses having a rise time of 3000 μs . The "effect curves" for a 0.1-0.9 probability of discharge were plotted on the basis of 100-200 voltage pulses with a shield in each of various different positions. From the data have been established the dependence of the maximum electric field intensity at the surface of the top flange on the altitude of the shield (height of the tube), the dependence of the electric strength of the support structure on the altitude of the shield, and the dependence of the maximum electric field intensity at the toroid surface on the radius of the base toroid with the toroidal shield assembly at various elevations or on the shield assembly elevation with various toroid radii. The results indicate that effective shielding of the top flange makes the electrical strength of the insulator support structure depend only on the electrical strength of the shield-pedestal gap and that it is maximum with the shield mounted above the lower edge of the top flange at a distance which depends on the flange radius as well as the toroid radius. Suppression of the streamer corona in such a configuration requires an auxiliary small shield at the

level of the lower edge of the top flange and this, in turn, will alter the optimum elevation of the main toroid for maximum electrical strength of the insulator support structure. A determining factor now is the difference between the radius of the base toroid in the main shield and the radius of the auxiliary toroidal shield. Increasing the radius of the base toroid effectively raises the optimum elevation of the main shield and increases the strength of the shield-pedestal gap, thus increasing the strength of the insulator support structure. Figures 6; references 10: 8 Russian, 2 Western. [125-2415]

UDC 621.316.99

DESIGN OF GROUNDING ELECTRODES FOR PERMAFROST SOILS

Minsk 'YUNESTIV' VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 80 pp 18-24 manuscript received 5 May 80

AL'TSHULER, E. B., candidate of technical sciences, docent

[Abstract] The design of grounding electrodes includes determining their type as well as their dimensions and spacing in order most economically to ensure safety of power equipment. Here installation of grounding electrodes in a permafrost soil is considered, where the vertical profile of the electrical conductivity follows the relation $\sigma_1 = \sigma_{10}(1+\epsilon z)^2$ in the top layer ($0 \leq z \leq h_1$) and $\sigma_2 = \sigma_{20} = \text{const}$ below ($h_1 < z < \infty$) (σ_1 denoting the electrical conductivity at the surface, z denoting the depth coordinate, h_1 denoting the critical depth, and parameter ϵ , positive or negative, characterizing the nonhomogeneity of the top layer). On this basis the resistance is calculated of a current carrying cylindrical electrode in various positions: vertical and short so as to remain entirely within the top layer, vertical and long so as to extend below the top layer, and horizontal buried within the top layer. The corresponding voltages and voltage gradients along these electrodes are also calculated. In the case of a horizontal electrode the depth of embedment is also taken into account. The results should be useful in the design and the installation of grounding electrodes for protection of power equipment in the Far North. The paper was submitted by the Department (Kafedra) of Automation Principles and General Electrical Engineering, Noril'sk Industrial Evening Institute. Figures 3; references: 4 Russian. [126-2415]

UDC 621.318.3.001.24

CALCULATION OF THE ELECTROMAGNETIC PONDEROMOTIVE FORCE IN THE ACTIVE ZONE
OF AN IRON SEPARATOR WITH A PLANE-MERIDIONAL MAGNETIC FIELD

Moscow ELEKTRICHESTVO in Russian No 11, Nov 80 pp 71-76 manuscript received
16 Aug 78

SMOLKIN, R. D., candidate of technical sciences, and SAYKO, O. P., engineer,
Veroshilovgrad

[Abstract] Electromagnetic separators of the d.c. type are widely used for extracting iron particles and articles from loose bulk material such as coal or cement. The electromagnet consists of a 2-pole I-I-core with either two coils (one around each arm) or one coil (in the center) or a 3-pole I I-I-core with a single coil (in the center), these coils placed so as to produce in the active zone above the pole faces either a plane-parallel or a plane-meridional magnetic field. Here a plane-meridional magnetic field is considered, but the problem is reduced to that of a plane-parallel magnetic field by describing the former in one of the meridional planes so that the two linear coordinates of the cylindrical system can be regarded as analogous to two rectangular ones. The force in the active zone is now calculated from the basic field equation, as a vector, with expressions for the magnetic field intensity and its gradients given in the conventional Cartesian form. Numerical results for such an electromagnetic sheave or drum with an I-I-I-core are shown in terms of geometrical ratios and dimensionless coordinates, based respectively on calculations and measurements at various points in a meridional plane. They indicate where and how much correction to the analytical approximation is necessary in actual design practice, as well as the proper approach to design optimization. Figures 4: tables 2: references: 9 Russian. [125-2415]

UDC 621.335.9

BALANCING OF LOAD IN A SYSTEM OF TRACTION ELECTRIC DRIVE OF SELF-PROPELLED MINE
CARS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian
No 12, Dec 80 pp 1319-1322 manuscript first received 11 Dec 79, after completion
23 May 80

ZHEMCHUGOV, NIKOLAY I., candidate of technical sciences, assistant, Donetsk Poly-
technical Institute

[Abstract] During movement of a self-propelled mine car at a turn, because of the nature of the motion system (the wheels of each side are brought into motion by separate traction motors), a redistribution of the load between the side traction motors takes place. The present paper proposes to balance the load at a

turn by means of a winding connection of the motor at the lagging side by means of a special circuit. The method of shaping of the motor load with existing and proposed circuits is shown. Operation over a 3-year period of 5VS-15 cars with the improved system of traction electric drive at mines of the production associations "Beloruskal" and "Artemsol" confirmed the effectiveness of the method considered for balancing a load. Figures 3; references: 10 Russian.
[149-6415]

UDC 621.335.625.2.012.858:538.65

MAGNETIC SUSPENSION SYSTEMS FOR CONTACTLESS TRANSPORT

Moscow ELEKTRICHESTVO in Russian No 12, Dec 80 pp 35-41 manuscript received
20 Apr 80

BOCHAROV, V. I., FRISHMAN, Ye. M., candidate of technical sciences, LIBERMAN, V. L. and SMOLENCHUK, V. S., engineers

[Abstract] An analysis is made of magnetic suspension systems for contactless transport now under development. Four types of magnetic suspension systems are known: 1) Electromagnetic suspension; 2) Electrodynamic suspension; 3) Suspension with the aid of permanent magnets; and 4) Various combinations of magnetic suspensions. Common to all of these systems is the use of the ponderomotive forces of the interaction of magnetic fields for accomplishment of contactless suspension (levitation) of transport means. The principles of action of these three basic types of magnetic suspension are considered as well as their power, energy and dynamic characteristics. Some of the history of the various magnetic suspension systems, their shortcomings and merits, and the difficulties of their realization are discussed. It is noted that realization of the methods of magnetic suspension is found in intimate connection with the possible sphere of application and the technical-economic indices of the system. Contactless transport systems with magnetic suspension of vehicles can find use not only for high-speed transport but also for local traffic of the type "city-suburb" and "city-airport" as well as for the needs of industrial transport. Figures 4; references 12: 5 Russian, 7 Western (1 in translation).

[148-6415]

ELECTRICAL EQUIPMENT AND ENERGY CHARACTERISTICS OF A HIGH-POWER ELECTRIC-ARC D.C. GENERATOR

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 81 pp 105-107 manuscript received 8 Apr 80

SERGIYENKO, A. S., candidate of technical sciences

[Abstract] A converter of electric-arc energy to direct current is described which can deliver a power of up to 1.5 MW. It consists of water-cooled copper electrodes, a cathode (10 cm long and 2.5 cm in diameter) and an anode (5 cm long and 3 cm in diameter), also a segmented interelectrode insert (2 cm long and 2 cm in diameter). The clearances between segments are slanted at 60° to the channel axis, which improves the stability of generator operation and shields the insulation interlayers against radiation from the arc. Air serves as the plasma forming gas. It is pumped from a compressor through tangential orifices into the cathode-insert gap and into the anode-insert gap at a constant rate of 5 g/s each, but between the insert segments at a variable rate from 5 to 20 g/s so that the total rate varies from 15 to 30 g/s. The generator auxiliaries include a ballast series resistor, a high-speed switch, a 10/2000 A circuit breaker, a bank of six 500 A ignitrons, another high-speed protective switch, a 1.7 MVA 2600/10 V power transformer Y/Y₁₂-connected with an autonomous voltage equalizing reactor, and a 6 kV busbar. The current-voltage characteristics are not steep and shift toward higher voltages under stronger gasdynamic action. The thermal efficiency reaches 0.5-0.67, increasing linearly as the air rate increases from 15 to 30 g/s at a current of 800 A and decreasing as the current increases from 400 to 2000 A at a constant air flow rate of 20 g/s. The electrical efficiency ranges from 0.28 to 0.63, the generator can produce a gas stream with a mean-mass enthalpy of 5600-9600 kJ/kg corresponding to temperatures of 3400-4800 K. The paper was submitted by the Department (Kafedra) of Electrical Equipment for Industrial Enterprises, Municipalities and Farms, Order of the Red Banner of Labor Belorussian Polytechnical Institute. Figures 3; references: 2 Russian.

[126-2415]

INVESTIGATION OF RESONANCE RANGES OF VIBRATION OF SMALL INDUCTION MOTORS

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR: SERIYA TEKHNICHESKIKH NAUK in Russian Vol 33, No 5, Sep-Oct 80 pp 53-55 manuscript received 29 Nov 79

ARTEMYAN, G. L. and MARTIROSYAN, V. A., Scientific Research Institute of Electrical Machines

[Abstract] In order to reduce both noise and vibration of electrical machines, it is necessary to design them with the optimum dynamic characteristics on the basis of theoretical and experimental analysis of prototypes. Such a study,

aimed at determining the resonance frequencies, was made on 4AA5 A2, 4AA56B4 induction motors. Measurements were made with a Brüel & Kjær instrument according to GOvernment STandard 12379-66, with the motors running light under a nominal voltage of 380 V and under a reduced voltage of 100 V. The amplitude-frequency characteristics reveal rotor resonance peaks at 1070, 990, 880 Hz respectively and stator resonance peaks at 2500-4500, 3700, 2400 Hz respectively. The excitation forces are mainly mechanical in 4AA50A2 and 4AA56B4 motors, magnetic in 4AA63B4 motors. Figures 2: tables 1; references: 5 Russian.
[130-2415]

ELECTROACOUSTICS

UDC 621.37/39:534

SPECIFICS OF AMPLIFICATION AND GENERATION OF ACOUSTIC WAVES IN THE GEOMETRY OF A KORBINO DISK

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2634-2638
manuscript received 30 Aug 79

GULYAYEV, Yu. V., MANSFEL'D, G. D. and POLZIKOVA, N. I.

[Abstract] A study is made of the interaction of free electrons and acoustic waves propagating within a piezo-semiconductor crystal cut in the shape of a Korbino disk and placed in a magnetic field. The principle of operation of the circular oscillator thus produced is as follows: as the acoustic waves propagate through the disk they interact with drift electrons and propagate primarily along the perimeter of a rectangle determined by the piezoactive directions in the semiconductor. Equations are presented for determination of the gain and phase alteration of the acoustic waves as a function of the angles between the corners of the rectangles along which the waves propagate in the crystal. Effective generation of acoustic waves with a rather broad beam and a radial drift velocity of the electrons of significantly less than the speed of sound is possible in a Korbino disk. Figures 3; references 10: 6 Russian, 4 Western.

[142-6508]

ELECTROMAGNETIC WAVE PROPAGATION, ELECTRODYNAMICS

UDC 537.874.3

SOLUTION OF THE INVERSE PROBLEM OF REFRACTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2504-2509
manuscript received 16 Oct 79

PAVEL'EV, A. G.

[Abstract] In contrast to radio transmission problems, when bistatic radar studies are made of the planets by means of two satellites, there is no algorithm for determining the profile of the index of refraction $n(h)$ on the basis of the function $\xi(p)$. One reason for this is the difference in the integral connection between the functions ξ and p . For radio transmission through an atmosphere, one of the limits of the integral expressing ξ as a function of p varies linearly with p . For bistatic radar studies, the limits in the integral of refraction are constant (ignoring relief). The same situation arises when the properties of the terrestrial atmosphere are studied by determination of the angle of refraction of various radio astronomical sources. The purpose of this article is to present a plan for solution of the inverse problem of refraction for bistatic radar studies of the planets. An expression is produced which can be used to calculate the angle of refraction based on a predetermined profile of index of refraction, i.e., solution of the direct problem of refraction. The expression is reduced to a dual discrete Fourier transform and applied to the solution of the inverse problem. The accuracy of solution of the inverse problem depends on the values of the limits of integration upon transition of the equation to its discrete form, and also depends on N . The specifics of the discrete Fourier transform allow the interval of sighting distances for which the inverse problem is solved to be selected. The selection can be based on the accuracy of experimental measurements, or on a priori estimates of the sensitivity of the angle of refraction to certain characteristics of the profile of the index of refraction. Figure 1; references 11: 10 Russian, 1 Western in translation.
[142-6508]

UDC 537.874.6

DIFFRACTION ON A SMALL APERTURE IN A CONDUCTING SCREEN IN THE PRESENCE OF FERRITE SPHERES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2510-2520
manuscript received 11 Mar 79

LAUNETS, V. L., MERINOV, E. K. and CHERNYGA, V. V.

[Abstract] Various types of devices have been created which utilize the phenomenon of coupling between lines transmitting electromagnetic oscillations by resonating ferrite specimens, usually spherical. The calculation of the coupling between cavities by means of ferrite specimens involves significant mathematical difficulty.

so that authors usually make a number of rather coarse assumptions, including the assumptions that ferrite spheres can be represented as magnetic dipoles, that the ferrite sphere which is acting as a radiator is located "within" the connecting aperture, and the assumption that the parameters of the interaction can be defined as for resonant field values. The authors of this work have solved the problem using methods of diffraction theory. In the design of a bandpass ferrite filter using intersecting rectangular wave guides, good agreement was obtained between calculated and experimental data. The self-similar field method used by the authors is more precise and convenient than the Green function method which has been used in the past, though perhaps more cumbersome. After determining the fields reradiated by the aperture and the fields at the surface of the aperture, the authors solve the boundary-value problem and thus produce an ordinary system of linear algebraic equations which can be used to determine the desired quantities. Numerical examples of particular cases are compared with experimental values. For most practical calculations, nonresonant precession can be ignored, greatly simplifying calculation equations and decreasing machine time requirements. The direct reradiation of the aperture is found to be negligible. Direct reradiation by the aperture has practically no influence on dispersion. Consideration of the eddy portion of the fields in the exciting aperture significantly changes the calculated reradiating capacity far from resonance. Figures 4; references 16: 13 Russian, 3 Western (1 in translation).

[142-6508]

UDC 538.311.001.24

EQUIVALENT ELECTRICAL PARAMETERS OF LAMINATED NONFERROMAGNETIC MEDIA PENETRATED BY AN ELECTROMAGNETIC PULSE FIELD

Moscow ELEKTRICHESTVO in Russian No 11, Nov 80 pp 22-26 manuscript received 5 Feb 80

PIS'MENNY, E. I., Kharkov

[Abstract] For a performance analysis of electromagnetic pulse generating devices by the "equivalent circuit" method, equivalent electrical constant parameters of a multilayer nonferromagnetic medium in an electromagnetic pulse field are defined so as to minimize the difference between actual and "equivalent circuit" instantaneous values of the energy in such a medium. The principle is demonstrated on a triple-layer system consisting of a plate (thickness d , electrical conductivity σ_1 , magnetic permeability μ_1) and a conducting half-space (thickness very large, electrical conductivity σ_2 , magnetic permeability μ_2) separated by an air gap of width h . Expressions for the equivalent inductances in series and shunting resistances are obtained on the basis of the magnetic field energy and the Joule-effect heating in each layer (no heating and infinitely high resistance in air). Calculations according to field theory and calculations according to circuit theory are made to agree as closely as possible, by the method of least squares, over the entire given time interval. The procedure has been programmed for a computer. Here numerical data are shown for the

trivial case of a conducting half-space alone, for a bimetal conductor consisting of a copper plate and a steel plate separated by a coating, and for a shield placed near a conducting structure. A comparison of the results with those obtained by other conventional methods indicates that this proposed simpler method is sufficiently accurate. Figures 3; tables 2; references: 7 Russian. [125-2415]

UDC 588.7

INTERACTION OF AN ELECTROMAGNETIC FIELD WITH A NONHETEROGENEOUS CONDUCTING CYLINDER

Novocherkansk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 12, Dec 80 pp 1263-1268 manuscript first received 13 Jun 78, after completion 15 Jan 79

STEBLEV, YURIY I., candidate of technical sciences, fulfilling responsibility of docent, Kuybyshev Aviation Institute, and POLULEKH, ALEKSANDR V., assistant, Kuybyshev Aviation Institute

[Abstract] A study of the structure of the electromagnetic field of nonheterogeneous conducting bodies is of importance during creation of the means for electromagnetic flaw detector production. An investigation of the structure of the secondary field of a nonheterogeneous object is necessary for the development of methods of optimum selection, processing of data concerning defects in items and solution of problems of quantitative determination of the parameters of defects. In the present paper the problem is solved of calculating the secondary electromagnetic field of linearly-extended defects of the type of stratified, subsurface cracks and the like. One of the possible calculation models of such a type of defects is used in the solution--a cylinder with a nonconcentric cylindrical insertion. Figures 4; references: 2 Russian. [149-6415]

UDC 621.3.013.24:621.316.974.001.24

CALCULATION OF THE ELECTROMAGNETIC FIELD IN MULTILAYER MEDIA

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian No 5, Sep-Oct 80 pp 53-64 manuscript received 25 Apr 79, after revision 25 Sep 79

RUZHINSKIY, L. N. and GRUBOV, A. P., Kharkov

[Abstract] A practical engineering method of calculating the electromagnetic field due to a periodic current distribution is developed which applies to multilayer media, also with a number of layers exceeding the conventional two or three. The conductors carry an alternating current and form an array of dipole pairs.

all connected into a 3-phase system. The current density is assumed to be uniform in each conductor, the conductor cross section being sufficiently small to make the effect of eddy currents on the resultant current distribution negligible. The problem is solved first for a star with 2 or 3 layers in a rectangular system of coordinates stationary relative to the machine, and then in a system of cylindrical coordinates. The method is applied to the specific case of a rotating electric machine with the air gap bounded by two semiinfinite half-spaces and the stator current concentrated in an infinitesimally thin sheet at the surface. Expressions are derived for the impedance of such a multilayer system and for the eddy-current power loss which include the effects of armature reaction and stator shielding. A rotor with and without a center hole is considered. Figures 3: references 15: 12 Russian, 3 Western. [124-2415]

UDC 621.3:538.3

ONE-DIMENSIONAL PROBLEMS OF PULSE PENETRATION OF ELECTROMAGNETIC FIELD INTO MOVING CONDUCTORS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA in Russian No 12, Dec 80 pp 1257-1262 manuscript first received 1 Sep 17, after completion 26 Nov 79

BATKILIN, YAKOV M., senior engineer, Khar'kov Polytechnical Institute, and MIKHAYLOV, VALERIY M., candidate of technical sciences, docent, Khar'kov Polytechnical Institute

[Abstract] The basic assumptions used in a statement of the problems of calculating the pulse electromagnetic fields in systems with a moving conducting sheath are outlined. An analysis is made of the compression and expansion of the sheath. The penetration of the field into the solenoid and other connecting bodies as well as the flow of current into the discharge circuit are taken into account. Methods are presented for solving the problem on a digital computer with the aid of the differential method. It is shown that with an increase of the speed of movement, an intensification results of the field penetrating into the sheath because of the compression of the magnetic flux. The nature of the dependences obtained conforms with known experimental data. Figures 3: references 12: 10 Russian, 2 Western in translation. [149-6415]

HOMOGENEOUS PROBLEMS OF THE GENERALIZED METHOD OF NATURAL OSCILLATIONS FOR BODIES OF ROTATION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1526-1529
 manuscript received 12 Feb 79

VOYTOVISH, N. N.

[Abstract] The application of the generalized method of natural oscillations previously developed by the author [N. N. Voytovich, et al., "Obobshchennyy metod sobstvennykh kolebaniy v teorii difraktsii", Nauka Publishers, 1977] to the solution of electromagnetic wave diffraction problems leads to homogeneous boundary problems with vector equations which have a spectral parameter in one of these equations or in the boundary conditions in the general case. If the body at which the diffraction occurs has axial symmetry, the relevant differential equations can be formulated in a standard fashion in terms of two scalar potential functions. In this case, a variational approach in general form becomes inconvenient, since the direct substitution of vector functions in the functionals in terms of scalar potentials increases the order of differentiation. The following homogeneous problems are formulated in this paper for bodies of rotation and the variation tools for their solution are explained: 1) The problem of the 'natural impedance' of the boundary of a body, a homogeneous variant of the Voytovich generalized method in which the eigenvalue is introduced in terms of impedance type boundary conditions. Such problems arise in the study of both open and closed systems. 2) A special case of such problems where the natural oscillations in axially symmetric systems are broken down into two types: E_{0n} and H_{0n} , where the homogeneous problem decays into two independent scalar problems. 3) A homogeneous problem in which the eigenvalue is the 'transmittance' of the boundary. The purely mathematical treatment is predicated on the earlier work of the author and no practical application or experimental confirmations are noted in this short communication. Figures 1; references: 2 Russian.
 [317-8225]

THE SYNTHESIS OF RESONANT ELECTROMAGNETIC FIELD SOURCES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1338-1347
 manuscript received 30 Mar 79

OSHLAKOV, A. K. and PEROV, V. P.

[Abstract] A resonant electromagnetic field is defined as a field for which the Poynting vector written for the complex amplitudes is a real quantity at any point in the space external to the source. The sources of these fields have such useful properties as the lack of a reactive component in the internal and mutual

impedances, a reduced level of induced impediment as well as generation simplicity. The synthesis of such sources is accomplished by representing the system of sources in the form of the superposition of multipole (spherical) harmonics. Equations are written and solved in order to determine the sufficient conditions for the radiated power to be zero. All the properties of the resulting resonant field are analyzed. The structure of electrical sources of a resonant field is illustrated with the derivation of the equations describing the field generated by an arbitrary electrical field source. Additional expressions are found for the sources of a field which fits a specific directional pattern and the total power produced by two sources comprised of superimposed electrical and magnetic currents. The purely theoretical analysis is not illustrated with any numerical examples or experimental data. References 5: 4 Russian, 1 Western. [317-8225]

UDC 621.372.8.001.24

EXCITATION OF A RADIALLY HETEROGENEOUS SPHERE WITH ELECTRIC AND MAGNETIC CURRENTS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2481-2490
manuscript received 3 Mar 80

PEL'D, Ya. N. and PEL'D, S. Ya.

[Abstract] The method of variation of constants, developed earlier to solve problems of excitation of bodies by an arbitrary system of currents, is extended to the case when it is necessary to consider the presence of waves with a continuous spectrum. The problem is reduced to integration of Maxwell's equations with fixed electric and magnetic currents and assigned boundary conditions at the surface of the sphere and at infinity. The solution is constructed by expansion of the corresponding spectra with respect to partial waves with coefficients dependent on one primary coordinate θ . The study involves excitation by an arbitrary distribution of 3-component electric and magnetic currents, for fields dependent on the azimuthal angle. The solution is obtained in the standard form for the theory of excitation of wave guides. Equations (24), (26), (31) and (32) provide a solution to the problem of excitation of a sphere by an arbitrary system of currents. References: 8 Russian.
[142-6508]

ELECTROMAGNETIC INTERACTION BETWEEN ELEMENTS OF A PERIODIC SYSTEM OF UNBALANCED STRIP LINES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2542-2547
manuscript received 3 Oct 79

KOSHEVOY, G. I. and SOLOGUB, V. G.

[Abstract] An analytic study is presented of the influence of electrostatic and electrodynamic coupling between elements in a periodic system in an unbalanced strip line on the characteristics of the primary quasi-TEM wave propagating through it. Based on a system of two coupled integral Fredholm equations of the first kind to which the problem is reduced and using the Rayleigh method, simple analytic expressions are produced for the case when $\kappa \ll 1$ (where $\kappa = \kappa \ell / 2\pi$, ℓ is the period, $\kappa = \omega/c$, c is the speed of light in free space) for the running capacitance and propagation constant, and corrections are generated for the electrostatic and electrodynamic interaction between the strip lines. This allows an upper estimate to be produced for the influence of other lines on the propagation of the primary quasi-TEM wave in a separate strip line in an arbitrary system. Figures 1; references 9: 8 Russian, 1 Western.
[142-6508]

ELECTRON AND ION DEVICES; EMISSION;
GAS-DISCHARGE AND ELECTRON-BEAM DEVICES

UDC 537.533.3

RELATIVISTIC HIGH-CURRENT ELECTRON BEAMS IN VACUUM

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2410-2418
manuscript received 23 Apr 80

LEYMAN, V. G.

[Abstract] A solution is found for the self-consistent problem of limiting currents of relativistic electron beams in planar geometry, and conditions are derived for transverse equilibrium and the corresponding cross sectional distribution of charge density and current density in the beam with consideration of the particulars of beam formation in the vicinity of the electron gun. The principal assumption on which the analysis is based is that the beam is laminar. The equilibrium conditions of such beams in a homogeneous magnetic field are found for two kinds of beam formation: hard formation where the cathode of the electron gun is penetrated by the total magnetic flux, and soft formation where the magnetic flux passing through the cathode is negligible. For each of these cases the author finds the velocity distribution, density, and intrinsic electric and magnetic fields as a function of coordinates and of the geometric and electron-optical parameters of the problem. The expressions found for limiting currents are compared for hard and soft types of beam formation. It is found that limiting currents exist when there is a gap between the surface of the beam and the surface of the shielding electrode, and they are about the same in both the hard and soft cases if the gap is large compared with beam thickness. As the gap approaches zero, the limiting currents become proportional to magnetic field intensity. It is concluded that soft formation of beams is even more advantageous than hard formation in the relativistic case as compared with nonrelativistic beams. If it turns out that surface beams with soft formation are stable, they might be promising for transporting record-breaking currents through vacuums. The author thanks A. A. Rukhadze for interest in the work and constructive comments. References 18: 15 Russian, 3 Western.

[105-6610]

ELECTRON TUBES:
ELECTROVACUUM TECHNOLOGY

UDC 621.385.612

CHARACTERISTICS OF NARROW-BAND NOISE SIGNAL IN AN O-TYPE TRAVELING WAVE TUBE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 23, No 12, Dec 80 pp 54-58 manuscript received 19 Sep 79

KATS, A. M., KLINAYEV, Yu. V. and GLEYZER, V. V.

[Abstract] An analysis of publications concerned with problems of the conversion of compound signals in a traveling wave tube demonstrates the complete absence of data with respect to an investigation of the statistical characteristics of amplified signals. An investigation of statistical characteristics, which is of independent interest in the scope of the theory of signals, has an applied value, especially if one speaks of the amplification of noise signals. Knowledge of the form of the distribution law of the envelope spectrum of the noise signal, amplified in a TWT, makes it possible to establish the magnitude of the confidence interval of the power spectrum and consequently to evaluate the operational energy characteristic of the device. Change of the form of a compound signal during its nonlinear amplification in a TWT involves conversion of its spectrum, which is of practical interest for evaluation of the redistribution of the noise output in the operating frequency band and the width of this band. Solution of the problems involved call for use of a successful model of a narrow-band noise signal and a model of the interaction in a TWT. In the present paper the source of normal noise is modelled according to a 1953 work by S. Rays, as the sum of independent harmonic oscillators with random amplitude and phase. Use of the single-frequency TWT theory for analysis of the characteristics of narrow-band noise at the output of the device is proposed. The narrow-band process is modelled according to a prescribed correlation function, i.e., an assembly is used of sinusoidal sources with amplitudes proportional to the square root of the function of the spectral density of power and to random uniformly distributed phases. The method of provisional series and smoothing with the aid of spectral windows is used for the analysis. Figures 5: references 7: 6 Russian, 1 Western in translation.

[150-6415]

UDC 621.385.633.24

STATIC CYCLOIDALITY AND NONLINEAR EFFECT IN MAGNETRON TYPE BEAM DEVICES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, July 80 pp 1483-1487 manuscript received 2 Apr 79

KULIKOV, M. N., SAFAROVA, Ye. A. and STAL'MAKHOV, V. S.

[Abstract] Along with the known factors occasioning breaks in the characteristic of a magnetron type backward-wave tube used as an oscillator, are related to reflection from the ends of the interacting system. It is in

hypothesized that there should exist yet another mechanism for the appearance of these breaks in the response related to the specific features of the static behavior of electrons in crossed fields. This paper is a theoretical test of this hypothesis and analyzes the cycloidal nature of electron motion in detail. It is shown that the static cycloidal nature of the electron flux is directly related to anomalies in amplitude and phase characteristics of magnetron BWT's. A new mechanism is demonstrated in order to account for the discontinuities in the response, which involves the forced distribution of the electron emission at the interacting system where static cycloidal is present. The derived equations for the fields were computed numerically on an M-200 computer and the calculated data are used to plot the distributions of the microwave field over the length of the BWT, the curve for the loss of synchronization parameter as a function of wavelength as well as the trajectories of individual electrons in the cycloidal flow. The resulting breaks in the frequency characteristic cannot be eliminated by reducing the reflections from the ends or the various inhomogeneities in the interacting system. They can be eliminated only through an appropriate choice of the cycloid parameters, i.e. by control of the beam parameters in the crossed fields. Sharp phase changes with a change in the signal frequency should also be observed with such cycloidal in magnetron TWT's in a nonlinear mode, though these phase distortions should be less pronounced in TWT's than in BWT's.

Figures 3; references: 8 Russian.

[317-8225]

ENERGY SOURCES

UDC 621.039.557:621.1

EFFECT OF FLUCTUATIONS OF THE AMBIENT TEMPERATURE ON THE PERFORMANCE PARAMETERS OF THERMOELECTRIC GENERATORS

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian No 5, Sep-Oct 80 pp 147-153 manuscript received 4 Apr 79

KOZLOV, Yu. F. and OGANOV, E. P., Moscow

[Abstract] Radioisotope-type thermoelectric generators for surface applications, operating in an air atmosphere characterized by natural temperature fluctuations, feature an outstandingly long autonomous service. Seasonal and monthly temperature fluctuations are sufficiently slow so as not to significantly perturb the quasi-steady operating conditions, but the relatively wide and fast diurnal fluctuations do. Here the effect of the latter on the generator performance is estimated by a mathematical simulation which yields adequate results without a need for lengthy and costly tests. The method has been validated experimentally in a study of load transients. Nonsteady performance modes are also calculated by discretization of the generator temperature into isothermal space zones and time intervals. The method is applied to the Beta-C generator with thermal insulation, a cooling radiator, an inner biological tungsten shield and an outer biological lead shield, in addition to the radioisotope container and the thermoelectric converter. The ambient temperature is assumed to vary according to the relation $T_a = 20 + 20\cos\left(\frac{2\pi}{24}\tau - \frac{\pi}{2}\right)^\circ\text{C}$, where τ denotes the time in hours measured from the instant a fluctuation begins. Numerical results have been obtained for the temperature of both hot and cold junction, the thermal flux, the output power, the voltage and the efficiency. Both the average value of each parameter and the maximum relative deviation from it are included, without and with the thermal inertia of the generator components taken into account. In the latter case the corresponding phase also shifts relative to the zero-inertia condition. Thermal inertia is found to decrease to almost half the amplitude of temperature fluctuations of hot junctions but to increase the amplitude of fluctuations of the electrical output power. Figures 3: tables 1; references 8: 7 Russian, 1 Western in translation.

[124-2415]

INFRARED

UDC 621.375.826

A METAL-OXIDE-METAL DIODE AS A MIXER IN THE INFRARED BAND

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 11, Nov 80 p 33

RIVLIN, A. A.

[Abstract] A metal-oxide-metal mixer detector is a unique uncooled wide-band quick-response ($\tau \approx 10^{-15}$ s) laser radiation receiver. This article gives some characteristics of W-Ni MOM diodes in the infrared range with mixing of two and three signals. In the former case, signals of two CO₂ lasers emitting powers of 150 mW each on lines P(20) were mixed on a point contact. The diode antenna was a tungsten needle 7 μm in diameter. Short-focus NaCl lenses were used to concentrate the emission on the needle. Beat signal amplitude and conversion losses were studied as a function of bias current on the diode, junction resistance, and emission power of the signal laser. It was found that they way the amplitude of the beat signal depends on bias current is determined by the detection mechanism. At low junction resistances the Schottky mechanism prevails, while at high resistances the tunnel mechanism is predominant. In three-signal mixing, a CO₂ laser was used with a diffraction grating simultaneously generating lines P(18) and (12 mW) and P(20) (68mW) together with a 5-mm klystron. A beat signal was observed on 33 MHz. At junction resistances in excess of 100 ohms, the beat signal decreases with increasing bias current. At lower resistances the beat signal is independent of bias. Besides, mixing increases noises, which makes the diode unsuitable for three-frequency mixing. Figures 3; references 6: 5 Russian, 1 Western.

[129-6610]

INSTRUMENTS, MEASURING DEVICES AND TESTERS,
METHODS OF MEASURING, GENERAL EXPERIMENTAL TECHNIQUES

UDC 531.74:535.854

SELECTING A RADIATION SOURCE FOR AN INTERFERENCE GONIOMETER

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 11, Nov 80 pp 29-31

KHOROSHEV, M. V.

[Abstract] The most effective way to improve the accuracy of angular measurements is to use coherent properties of optical emission. In order to determine the capabilities of various sources of coherent emission, the author considers expressions for the complex degree of coherence of radiation that enable selection of the source, the measurement facility and the conditions of operation of the instrument. Expressions are derived that describe the process of interaction of two coherent beams produced by a variety of sources under the conditions most frequently encountered in angle measuring work. These relations describe the operation of the instrument under stabilized conditions, and a special analysis is needed for determining the effect of temperature instability, atmospheric disturbances, and the errors of measurement of different components. The formulas can be used for choosing a laser when the requirements for emission coherence are known, or for determining the feasible region of application of a known laser for handling angle measuring jobs. Figure 1; references 4: 3 Russian, 1 Western in translation.

[129-6610]

UDC 531.715.1.029.65

APPLICATION OF TWO OSCILLATOR MODES IN MILLIMETER INTERFEROMETRY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2474-2476
manuscript received 23 Apr 79

SKIBENKO, A. I., FOMIN, I. P. and SKUBKO, V. A.

[Abstract] Diffraction emission oscillators are among the millimeter and sub-millimeter microwave sources currently being more extensively used for plasma diagnosis. These devices have a wider tuning range and higher sensitivity than conventional microwave sources such as masers, backward-wave oscillators, klystrons and the like. The authors investigate the conditions of electronic frequency modulation of diffraction emission oscillators. The frequency of emission was modulated by a especially developed sawtooth voltage generator producing a wave-shape with amplitude of 0-90 V, current of up to 300 mA, and duration between sawteeth of 50, 100, 250 and 500 μ s. This modulator was used on a diffraction emission oscillator in the millimeter band with wavelengths of 2, 4 and 6 mm. The percentage frequency modulation was determined by using an interferometer with arm difference of 15 mm and a resonator with $Q=10^4$. It is found that the slope of electronic tuning is only 0.3-0.5 MHz/V over a range of 40 MHz, suitable

for use in a phase meter with raster display of the phase shift. In addition to the low-slope diffraction emission mode, a high-slope backward-wave mode is also observed. The regions of emission in the two modes are adjacent to one another, and overlap in a 100 V interval. For a device on a wave-length of 6 mm, this corresponds to an accelerating voltage of about 2.4 kV, and an output power of about 1 W in the diffraction emission mode, and about 200 mW in the backward-wave mode. By using this effect in an interferometer with raster phase displacement display, a maximum shift of 30π and a minimum shift of $1/5\pi$ can be measured with arm difference of 10 mm. Figures 2; references: 4 Russian.
[105-6610]

UDC 535.853-1:2432.083

RADIATIVE AND CONVECTIVE HEATING OF SPECIMENS IN INFRARED SPECTROPHOTOMETERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 6, Jun 80 pp 4-5
manuscript received 16 May 79

VOROB'YEV, V. G. and YUSHKO, T. T.

[Abstract] The temperature of specimens during measurement in an infrared spectrophotometer is influenced not only by convective but also radiative heating. A study of both heating modes in $4000-200\text{ cm}^{-1}$ Perkin-Elmer 621, 457, 180 and Hitachi 225 spectrophotometers was made with specimens in various aggregate states: solids (fluorite, sodium chloride, indium antimonide), films (polystyrene, fluorocarbon), and liquids (indene). The temperature was measured with a copper-constantan thermocouple inside a ceramic sheath. The test time ranged from 5 to 80 min. Measurements were made with the test cell closed and open as well as without a specimen. The results indicate an appreciable role played by heating of the air due to absorption of infrared radiation by carbon dioxide and water vapor, as well as radiative heating of the test cell. During a sufficiently long time, moreover, any specimen is heated first convectively by the ambient air and then radiatively. Radiative heating, a source of measurement errors, can be reduced by means of heat filters such as think silicon wafers, but this will also degrade the energy characteristics of the instrument. Figures 2; tables 1: references: 4 Russian.

[119-2415]

UDC 539.234.621.52

OPTICAL CHARACTERISTICS OF DIELECTRIC COATINGS IRRADIATED BY A LASER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, Jul 80
pp 31-33 manuscript received 11 Jun 79

KADANER, G. I., MIRONOV, S. P. and OVCHINNIKOV, B. V.

[Abstract] Some optical characteristics of dielectric coatings were studied by laser photometry, in order to supplement the not so accurate and complete data obtained by conventional spectrometry. With a monopulse laser (two wave-lengths: 5.6 and 10.6 μm) as the light source, the optical density of multilayer ZnS+MgF₂ coatings on plane-parallel K8 glass substrates was measured as a function of the illumination energy density (up to 5 MW/cm^2) and of the laser beam incidence angle (from 0 to 40°). The coatings consisted of ZnS and MgF₂ layers alternating in various different patterns. The instrumentation included a light splitter and two channels, a rotating stage with the specimen in one, each with appropriate optics such as lenses and neutral light filters, also a milky glass plate followed by a photodiode and an oscilloscope in each. The results indicate a constant optical density of these coatings over the 1.7 kW/cm^2 - 5 MW/cm^2 range of illumination intensity and, therefore, the absence of transluminance effects during interaction of the laser beam with selectively reflecting films. With a change of the incidence angle, the maximum-reflection wavelength for these coatings shifts to longer ones. This trend is not affected by the attendant change in the illumination intensity, which in this case decreased by a factor of 1.3 as the incidence of the laser beam was changed from normal to 40° oblique. Figures 2; references: 5 Russian.

[118-2415]

UDC 621.3.043.536.6:66.015.24

THE 'STATOR-1' THERMAL SCANNER MEASUREMENT DATA SUPPORT

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 12, Dec 80 p 27

PADALKO, G. A.

[Abstract] An infrared thermal sensing viewer can be used for flaw detection in the steel of high power electrical machine stators. The stator being tested is induction heated with large AC currents and defective portions of the stator exhibit a temperature elevated 10°C or more above the average temperature of the internal stator surface. The Stator-1 infrared scanner was developed to observe the internal surface of a stator. It consists of an optical head mounted on a self-propelled chassis which moves inside the stator. The optical head circularly scans the stator and simultaneously moves along it, inspecting the entire surface. An electronics module is connected by a cable and contains a CRT display on which

the video signal is observed. The specifications are: a temperature resolution of 1°C , a scanning speed of 2 rev/sec, a linear resolution of 5 to 10 mm; a refocusing range of 0.45 to 1.5 m, an average self-propelled speed of 10 mm/sec and a recordable temperature range of 20 to 60°C . The video provides not only a thermal image of the internal stator surface, but also the location of the discovered flaw. Factors governing the instrument error are also discussed. It is noted that the temperature measurement error at 30°C is $\pm 2^{\circ}\text{C}$.

References: 4 Russian.

[146-8225]

UDC 621.37/.39.08

METHOD OF LOGICAL DETECTION OF RADIO PULSES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 11, Nov 80 pp 63-64

LATYSHEV, Yu. A., NOVIKOV, V. B. and SEL'SKIY, V. A.

[Abstract] In electronics it is sometimes necessary to measure the time parameters of radio signals when the carrier frequency is not exactly known beforehand. This is usually done by analog techniques. The authors propose a logical detection method for improving accuracy in measuring the time parameters of an isolated radio pulse. The signal is sent to the input of a shaper, and short pulses are taken from the shaper output corresponding to transitions of an input sine-wave voltage through threshold levels. The first pulse from the output, corresponding to the beginning of the input radio pulse signal, sets a flip-flop to the one-state, and a counter to zero. The positive potential from the flip-flop opens a selector. Clock pulses of given frequency go to the inputs of the first counter and another counter that sets a second flip-flop to the one-state upon overflow. This begins the shaping of a video pulse front. The other counter has the same capacity, and cannot overflow until it gets a reset pulse from the shaper. Upon completion of the radio pulse signal, this counter overflows and resets the flip-flops to zero. Thus the output video pulse gives the parameters of the input signal when the circuit parameters are known. Requirements for these parameters are analyzed. Figures 2; references: 3 Russian.

[129-6610]

UDC 621.375.826:621.391.8

MEASURING THE WIDTH OF THE STIMULATED EMISSION SPECTRUM OF PULSED AND CONTINUOUS LASER RADIATION

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 11, Nov 80 pp 27-28

BANTLE, N. O., DROZHBIN, Yu. A., KOLOSOV, A. V., PROKOPENKO, V. Ye., RASS, L. A. and STEPANOV, B. M.

[Abstract] A facility is described for measuring the spectral width of stimulated emission of cw and pulsed lasers in a wavelength range of 0.4-0.8 μm . Minimum

duration of investigated pulses is about $5 \cdot 10^{-8}$ s. Optimum radiation energy is determined by the total coefficient of attenuation of radiation in the instrument, and is $4 \cdot 10^{-4}$ J for $\lambda = 0.6 \mu\text{m}$ and $\Delta\lambda = 5 \text{ nm}$. The laser emission is sent through neutral filters for attenuation and then through a scattering lens to the input of Fabry-Perot interferometers in a vacuum chamber. Input and output in the chamber is through K-8 glass windows. The output beam is focused by an achromatic lens on the receiver--a KTP-39 industrial television camera. An attachment is included for isolating a single line at the camera output. The width of the emission spectrum is measured by determining the width of the image of the interference ring of the radiation on a given level. Error does not exceed $\pm 0.3 \text{ nm}$ when the wavelength is known within 0.1 nm . Figures 2; references 6: 5 Russian, 1 Western in translation.
[129-6610]

UDC 621.391.81:519.246.2

OPTIMIZATION OF PARAMETERS OF A MEASURER OF THE TANGENTIAL COMPONENTS OF A VELOCITY VECTOR

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKTRONIKA in Russian Vol 23, No 12, Dec '80 pp 31-35 manuscript received 16 Jul 79, after revision 24 Mar 80

KHROMYKH, V. G. and CHULYUKOV, V. A.

[Abstract] In contemporary methods of noncontact measurement of the parameters of movement, the necessity often arises for obtaining information concerning the tangential components of the velocity vector of moving objects. In a 1976 paper of which Khromykh was coauthor, a method is proposed for such measurements, based on the effect of space modulation of a field being recorded, originating because of the movement of a holographic object during the exposure time. The method in question can be used for realization of measurement of the tangential components of a velocity vector. An evaluation is made of the dispersion of one form of a nonuniform random field. This method of evaluation can be placed at the basis of an algorithm of measurement of the tangential components of a velocity vector with the use of the results of a holographic comparison of the structure of wave fronts reflected by a moving object. Figures 3; references 4: 1 Russian, 1 Western.
[150-6415]

NONLINEAR DISTORTIONS IN AN ACOUSTOOPTICAL SPECTRUM ANALYZER

Kiev IZVESTIYA VYSSHIKH ZAVEDENIY: RADIODIENSTNIKI in Russian Vol. 21, no. 11, Nov 80 pp 38-42 manuscript received 1 Apr 79, after revision 1 Oct 79

KULAKOV, S. V., MOLOTOK, V. V. and RAZZHIVIN, B. P.

[Abstract] An acoustooptical analyzer of instantaneous spectra is considered which consists of a monochromatic light source, a lens system and a collimator forming a plane wave, an acoustic light modulator, a set of lenses performing a Fourier transformation, and a recording instrument. Nonlinear distortions in this device are calculated for the most typical case of an analyzed arbitrary narrow-band signal with a known carrier frequency, both its envelope and phase being functions of time, with a space-time modulating signal in the modulator aperture. Only amplitude distortions occur when the modulator operates in the Bragg diffraction mode, there are also frequency distortions when it operates in the Raman-Nato diffraction mode. The respective upper limits of input signal level relative to either permissible distortion of the amplitude characteristic or permissible intermodulation distortion indicate that Bragg diffraction is more advantageous. The respective lower limits of the input signal level relative to sufficiently high signal-to-noise ratio at the modulator output indicate, furthermore, that a wider dynamic range of operation is possible with Bragg diffraction. Figures 4; references 6: 3 Russian, 3 Western (1 in translation).

[117-2415]

CRYOGENICALLY COOLED SEMICONDUCTOR BOLOMETERS WITH AN ISOLATED TARGET

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 6, Jun 80 pp 22-24 manuscript received 16 May 79

PANKRATOV, N. A., MALYAROV, V. G. and YENUKOVA, T. A.

[Abstract] The sensing element in classical cryogenically cooled bolometers serves as both absorber and thermometer. Design and performance requirements make it more expedient, however, to separate the two functions. Accordingly, there were developed bolometers with a separate target for heat absorption and a semiconductor crystal for thermometry. The authors have built two lots of bolometers with an isolated target. In the first lot the target is a disk of copper foil 2 mm in diameter and 4 mm thick with a 10-20 μ m thick ferrite coating, in the second lot the target is a 2x2x0.3 mm³ large sapphire wafer with a similar ferrite coating. The sensing element in both lots is an approximately 400x500x680 μ m³ large Ge:Ga crystal. These bolometers have a higher thermal capacity than earlier ones of this type and, therefore, the difference between readings of the equivalent noise power measured electrically and optically at f= 12.5 Hz is also larger. The components of their thermal capacity were determined from the lengths of the time constant at T= 2 K with cover, without cover,

and without target. The three noise components, determined respectively by the contacts, the surface, and the material, can at large bias currents increase appreciably but at different rates. Tables 2: references 9: 3 Russian, 6 Western.

[119-2415]

UDC 621.396.96

DESIGN OF MEASURERS OF THE PARAMETERS OF PASSIVE INTERFERENCE BASED ON ALTERNATING PERIOD COMPENSATION CIRCUITS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOTEKHNika in Russian Vol 23, No 12, Dec 80 pp 82-84 manuscript received 13 Jul 79

KOSHEVOY, V. M. and MEDVEDIK, A. D.

[Abstract] The feasibility is considered of designing a measurer of the phase and modulus of an interperiod correlation coefficient based on the alternating period compensation circuits widely used as systems of protection from passive interference. The principles of design of measurers of the Doppler frequency (phase) and modulus of a correlation coefficient for two periods of sounding are based on the fact that the power of the noncompensated remainders at the output of an alternating period compensation circuit depends on the mean Doppler frequency and modulus of the interperiod correlation coefficient of interference.

Figures 3; references 6: 2 Russian, 2 Western.
[150-6415]

UDC 621.513.3.01

ON THE PROBABILITY OF TRACKING LOSS IN A SYSTEM WITH SECOND-ORDER FILTER

Moscow RADIOTEKHNika I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2301-2308
manuscript received 12 Apr 78, after revision 4 Feb 80

RESHETNYAK, S. A. and TRET'YAKOV, G. N.

[Abstract] An analysis is made of the probability of tracking loss in automatic electronic measuring equipment. The probability of tracking loss is defined as the probability of reaching predetermined limits as a result of tracking error. The state of the system is given by a point in phase space. The probability density of finding the system in the vicinity of some point in this space is determined from solution of the corresponding Fokker-Planck equation. The author finds an approximate solution of this equation for a specific tracking system based on a general approach to solution of linear kinetic equations. The analysis involved representing the solution as a series with respect of powers of a certain

evolutionary parameter. A formula for tracking \hat{x}_1 is derived for a tracking system with a second-order filter, and the limits of applicability of this expression are studied. The theoretical results are confirmed by computer modeling. The proposed method is applicable to an extensive class of phenomena described by Fokker-Planck equations. Figures 3; references: 7 Russian. [105-6610]

IL : 669.013.5 9'11.21

INSTRUMENT FOR TESTING MAGNETIC CHARACTERISTICS OF TRANSFORMER STEEL

Moscow Pribory i Sistemy UPRAVLENIYA in Russian No 12, Dec 80 p 28

ZHURAVSKIY, A. G. and KREPAKOVA, V. F., candidates of technical sciences, and NIKLAYEV, S. P., engineer

[Abstract] A description is given of an instrument, developed in the department "Electric Drive and Automation of Industrial Equipment", at Lipetsk Polytechnical Institute and now being used in the quality control of transformer steel at the Novolipetsk Metallurgical Plant, for the nondestructive testing of the magnetic induction and core losses of transformer steel. The instrument employs a contact-type magnetic property pickup (DMS) consisting of a shell-type cylindrical magnetic core in which is placed a magnetization coil. Two Hall-effect sensing elements are located in the gap between the magnetic core and the sheet of metal being tested. The sensing elements are so arranged that one registers the amount of magnetic flux passing through the sheet of metal in the direction in which it was rolled, and the other at an angle of 45 degrees to this direction. The DMS is attached by means of a flexible cable to a measuring unit which powers the DMS and processes its signals. In order to measure magnetic induction, the Hall-effect element placed in the direction in which the metal was rolled sends a signal to the input of an operational amplifier and the magnetic induction is determined by the magnetic flux registered. The measurement of core losses is based on the relationship of these losses to the type and degree of imperfection of the crystalline texture of transformer steel. Core losses are a function of the mean angle of deviation of crystallites from the direction of ideal orientation, i.e., the direction in which the metal was rolled. The difference in magnetic permeability in the metal's rolling direction and at an angle of 45 degrees to it is used as a characteristic of the steel's texture and of the degree of nonuniformity in it. The magnetic properties of the metal are determined in 1 to 2 min. The contact pickup weighs 1.5 kg and the measuring unit measures 280 X 180 X 160 mm. Figures 2; references: 3 Russian. [143-8831]

A STATISTICAL QUALITY CRITERION FOR THE OPTICAL SYSTEMS IN OPTOELECTRONIC PHOTOMETERS

Leningrad OPTIKO-MEKHANICHESKAYA PRIMYSHLENNOST' in Russian No 6, Jun 80 pp 6-8
manuscript received 13 Nov 79

BUKHONIN, Yu. S., YEGIZAROV, A. B. and KUZ'MICHEV, V. N.

[Abstract] The process of photometric analysis with an optoelectronic instrument is considered, namely determination of the space distribution of illumination in the stage plane of the optical system from measurement of its space distribution in the image plane. All instrument components except the optical system are assumed to have ideal characteristics. The classical method of estimating the mean-square error is used, with a priori data given about the Wiener spectrum of the stationary random function describing the illumination distribution sought. The constant component of this function is transmitted by the optical system without distortion. The effect of diffractional and aberrational distortion must be estimated and, for better accuracy, several measurement channels are used - each regarded as a two-dimensional band filter of space frequencies. Here calculations are shown for analysis with one channel, two and three channels, using the "degree of correlation" and the "relative structural content" characterizing the transfer function of a channel. Figures 1; references 6: 2 Russian, 4 Western (3 in translation).

[119-2415]

TIMING RELAY FOR PHOTOLITHOGRAPHIC PROCESSES

Moscow PRIBORY I SISTEMY UPRAVLENIYA in Russian No 12, dec 80 p 29

LEVIN, D. B. and GATCHINA, N. A., engineers

[Abstract] A description is given of a timing relay developed for use in production process units for the photolithography of microelectronic products. The relay is small and accurate and can form these independent delays over the range of 0.1 to 9990 s, with the entire range divided into the subranges 0.1 to 99.9, 1 to 999 and 10 to 9990 s, in intervals of 0.1, 1 and 10 s, respectively. The relay consists of three identical channels. The frequency of the industrial electrical network is used as a reference frequency and a signal is generated at the instant when the counted number of reference-frequency pulses agrees with the number set on the delay controller. The relay is constructed from series K155 microcircuits and is assembled on printed circuit boards inside a unified standard case. Three timing relays are placed in a single unit, each of which can form independent time intervals in any of the subranges indicated. A single channel contains a diode bridge which converts 50-Hz alternating voltage into 100-Hz pulsed voltage, the latter entering a pulse shaper assembled in a Schmitt circuit. From the shaper 100-Hz square pulses enter a frequency divider in the form of a three-decade asynchronous binary-coded-decimal operating in a 1-2-4-8 code. Each decade divides by 10 so that at the output of each decade pulses are formed with a repetition rate of 10, 1 and 0.1 Hz, representing the reference frequency pulses. Pulses from the output of one of the divider's decades, depending on the subrange selected, enter a three-decade asynchronous binary-coded-decimal counter operating in a 1-2-4-8 code. The binary-coded-decimal code for the number of pulses arriving at the counter as of the instant of the beginning of the delay is fed to one group of inputs of a coincidence circuit, at another group of whose inputs is set the code for the number of pulses corresponding to the end of the time interval to be formed. The end of the delay takes place when the codes coincide. Figures 1. [143-8831]

OPTOELECTRONICS, QUASI-OPTICAL DEVICES

UDC 621.384.321

SELECTION OF THE PASSBAND FOR AN OPTOELECTRONIC SYSTEM WITH SINUSOIDAL SCANNING LAW

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, Jul 80
pp 38-39 manuscript received 10 Mar 78

GALIAKBEROV, D. Sh., DOSKUTNIKOV, A. I. and OVSYANNIKOV, V. A.

[Abstract] The problem of selecting the passband of an optoelectronic system with an RC filter for maximizing the signal-to-noise ratio at the output is analyzed here in the case of a constant duration of the input pulse from the target and a scanning mirror which revolves sinusoidally. The filter transfer function (frequency characteristic) and the target detection probability, the latter averaged over the target dimensions, are calculated assuming a cosine-square directional characteristic. Also calculated is the relative time constant of the filter, referred to the pulse duration, as a function of the scanning efficiency (ratio of useful scanning time to scan period). Numerical results obtained with the aid of a digital computer indicate that the sensitivity of the system can be increased, i.e., the input signal can be decreased, without reducing the detection probability, by increasing the efficiency to 0.4-0.42, beyond which there will be no further improvement. The filter passband maximizing the detection probability is then 20-30% wider than that maximizing it at a constant duration of the input pulse and corresponds to relative time constant of 0.26-0.28 almost independent of the detection probability and the scan angle. The signal-to-noise ratio needed for a given detection probability does not depend on the scan angle below 40-50° but increases at wider angles. Sinusoidal scanning with that optimum efficiency requires an 8-12% higher signal-to-noise ratio than uniform scanning. Figures 2; references 4: 3 Russian, 1 Western in translation.

[118-2415]

UDC 621.385.833.22

THE CALCULATION OF SOME OF THE ELECTRONIC-OPTICAL PROPERTIES OF THE MULTIPLE LENS IMAGING SYSTEM² OF TRANSILLUMINATING ELECTRON MICROSCOPES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1499-1503
manuscript received 23 Feb 79

MAKAROVA, I. S., NYAKINKOVA, G. G. and YARMUSEVICH, Ya. S.

[Abstract] A procedure is proposed for directly calculating the paraxial properties and some of the aberration coefficients of the entire multiple lens system of a transilluminating electron microscope. The numerical differentiation and

integration in the computation of the equations for the trajectories and aberration coefficients are performed only within the effective fields of the lenses. The effective boundary of the field runs through the coordinate on the axis of the system where the field falls to 0.01 times its maximum value in the central gap of the lens system. It is assumed that in the remaining gaps between the lenses the electron trajectories are straight lines, while the field is zero. The techniques permits the computation the optical properties of such systems where the lenses are 'thick' ones as well as when they function without producing a real image. The operational modes of such multilens systems are determined which allow for the retention of focusing in the plane of the screen throughout the entire range of magnifications and accelerating voltages, and also provide for minimal isotropic distortion of the image at low magnifications or in the absence of image rotation for the identification of all rodifraction patterns. The practical example of a four lens imaging system with a projection lens similar to the JEM-1000 lens is analyzed and it is shown that at a magnification of 8,500x, there is no isotropic distortion of the total imaging system. The authors thank P. A. Stoyanov for the subject offered and for valuable comments. Figures 5; references 7: 4 Russian, 3 Western.

[317-8225]

OSCILLATORS, MODULATORS, GENERATORS

UDC 621.372.413:621.373.12

A RESONATOR WITH DOUBLE GRATING AS THE OSCILLATORY SYSTEM OF A SELF-EXCITED OSCILLATOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80 pp 2292-2300
manuscript received 12 Jul 79

MOROZ, Ye. Ye., SOROKA, A. S., TRET'YAKOV, O. A. and SHMAT'KO, A. A.

[Abstract] Resonant oscillators for the millimeter and submillimeter wave bands using the effect of diffraction emission owe such properties as frequency band, control characteristics and the efficiency of interaction between the electron beam and resonator field to a resonant electrodynamic system, which takes the form of an open or cavity resonator in which a periodic structure is placed. In this paper the authors calculate the geometry factor of such a resonator with double diffraction grating as the periodic structure. The double grating is formed by a reflective plate with regularly spaced ruled grooves parallel to a periodic system of bars of rectangular cross section. The electron beam passes between the two gratings. The bar grating enhances interaction between the electromagnetic field of the resonator and the electron beam, and also suppresses competition between near modes excited in the resonator. The optimum geometric parameters of such a resonator are determined that maximize the reflected impedance on a given frequency by producing the required field distribution of the wave interacting with the electron beam. Various cases of field distributions of the working harmonic are analyzed. The analytical expressions derived in the paper can be used in determining allowances when making structures of this type.

Figures 3; references: 6 Russian.

[105-6.10]

UDC 621.373.072.9

CONTROL OF THE SYNCHRONIZATION PARAMETERS OF NONISOCHRONIC OSCILLATORS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 12, Dec 80 pp 2593-2600
manuscript received 30 Jul 79

MINAKOVA, I. I. and FEDOSEYEV, L. G.

[Abstract] A study is made of the possibility of controlling the amplitude response of an oscillator to an external action and of controlling the width of its synchronization band for the case of autoparametric actions in an auto-oscillator with a nonlinear circuit and delay in the feedback loop. The study is performed both for oscillators with controlled delay (klystron oscillator, oscillator with artificial delay line in the feedback loop) and for oscillators with unregulated delay. The possibility is studied of controlling the nonautonomous mode of an oscillator. The amplitude response of an oscillator with unregulated delay can be increased or decreased by including semiconducting capacitors.

positive or negative reactive nonlinearity in the circuit. The amplitude response of an oscillator with nonlinear circuit can be decreased slightly or more than doubled by placing a regulated delay circuit in the feedback loop. The addition of regulated delay to the feedback loop can also vary with width of the band over which the synchronous operating point is maintained in oscillators with nonlinear capacitance. Figures 2. References: 13 Russian. [142-6508]

PHOTOELECTRIC PHENOMENA AND DEVICES,
ELECTROLUMINESCENCE, ION DEVICES

UDC 621.383.298

THE MECHANISM OF EXOELECTRON EMISSION FROM THE DYNODES OF A PHOTOELECTRIC MULTIPLIER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1495-1498
manuscript received 1 Mar 79

GLUKHOVSKOY, B. M. and YAROSHENKO, I. F.

[Abstract] Experimental curves showing the distribution of after-pulses in the FEU-87 and FEU-115 photomultiplier tubes are plotted; a characteristic feature of this distribution in the FEU-115 is the time delay of the formation of the after-pulses relative to the main pulse which amounts to about 3 microseconds. It is hypothesized that the reason for the formation of these after-pulses is exoelectron emission from the photomultiplier dynodes, and the experimental curve for the time distribution of the pulses is based on a vacancy-diffusion mechanism of the emission: the vacancies formed in the volume of the emitter diffuse to the surface and are annihilated with the liberation of energy. If the overall energy of a vacancy and the stimulating input (temperature) is sufficient to overcome the work function, then exoelectron generation is possible. A model for the generation of the after-pulses is described and a partial differential kinetic diffusion equation is solved for the exoelectron emission in accordance with this model. The theoretical curves are compared with the experimental data, showing good agreement. Analytical expressions are derived for emitters with wide and narrow forbidden bands and both cases substantiate the proposed mechanism. Figures 2; references 12: 9 Russian, 3 Western.
[317-8225]

POWER SYSTEMS (INCLUDING EFFECT OF
VARIOUS ITEMS ON POWER TRANSMISSION)

UDC 332:551.594.221

ESTIMATION OF THE ERROR IN MEASUREMENT OF THE LIGHTNING CURRENT AMPLITUDE WITH A
LOOP ANTENNA

Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 11, Nov 80
pp 101-104 manuscript received 15 Apr 80

DUL'ZON, A. A., candidate of technical sciences, docent, and RAKOV, V. A.,
engineer

[Abstract] The amplitude of lightning currents can be determined from direct, indirect, or remote measurements. Direct methods are most accurate but inefficient, also not expedient at low altitudes. Indirect methods such as magnetic recording are characterized by large errors, a rms error of 45% under most favorable conditions and $\pm 90\%$ with a 0.95 confidence coefficient otherwise. Hardly any data are available about the error of remote measurements, with a loop antenna. Here an estimate of this error is made on the basis of the relation between lightning current and measured magnetic field intensity. The error has four components. One error component is due to the inaccuracy of the mathematical model of discharge and can be reduced by correcting the model on the basis of experimental data. One error component is due to the inaccuracy of estimating the distance from a discharge on the basis of sound propagation, usually an error of underestimation which increases with shorter distances. One error component is due to substitution of the average altitude $H = 5$ km for the difficult to determine actual altitudes of lightning channels. Finally, one error component is due to drift and inaccuracy of instrument calibration. Quantitative estimates indicate that the total error of remote measurements with a loop antenna can be held within $\pm 85\%$ with a 0.95 confidence coefficient, not worse than the error of indirect measurements with rather inefficient magnetic recording. The paper was submitted by the Science Seminar, Scientific-Research Institute of High Voltages attached to Tomsk Polytechnical Institute. Figures 3; references 7: 3 Russian 4 Western (1 in translation).

[126-2415]

PRODUCTION TECHNOLOGY

UDC 621.315.6:621.38:53.089.68:006.065

APPLICATION OF SECTOR STANDARD MODELS AND SUBORDINATE SAMPLE MEASUREMENT FACILITIES TO SEMICONDUCTOR PRODUCTION

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 12, Dec 80 pp 9-10

KHOLODNYY, L. P. and ROGULIN, V. Yu.

[Abstract] A critical problem in the semiconductor production sector is the development of test circuits for the measurement of the physical properties of semiconductors using nonstandardized test facilities. This is an interim measure, since a large number of standard sector samples and measurement facilities are being designed at the present time. Standardization of samples and test gear will provide for uniformity in the measurements of semiconductor material parameters during various production stage testing and final quality control. This paper outlines the organizational requirements for the design and production of standard samples and test facilities for the sector: The development of the technical specifications for these facilities is to be implemented in line with GOST 8.315-79 and GOST 8.326-79 which define the procedure for the scientific research work. The standards setting engineering documentation is to be subjected to expert metrological evaluation in accordance with OST 48-158--79. The organizational functions of a scientific and engineering council as well as a metrological departmental inspectorate for the use of the standard sector samples and sample measurement facilities are discussed. The head organization of the metrological service is presently preparing the final drafts of the sectorwide standards "Rare-Earth Metal Products and Semiconductor Materials. Sectorwide Standard Samples of Properties. Procedure for Development, Approval and Applications" and "Rare-Earth Metal Products and Semiconductor Materials. Nonstandardized Subordinate Sample Measurement Facilities. Procedure for Development, Approval and Applications." These drafts will be approved by the end of 1980.

[146-8225]

UDC 621.316.8.08:621.317.7

A HIGH-SPEED INTERFERENCE-RESISTANT MEASUREMENT COMPLEX FOR INSPECTING METAL-FILM RESISTORS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 11, Nov 80 p 67

BPUSILOVSKIY, V. V. and BERFIS, Ya. M.

[Abstract] A multifunction measurement complex is described for quality control in the manufacture of metal-film resistors. The system includes a universal percentage bridge and two types of tolerance comparators for grading resistors according to a preset program. A fixed voltage from the percentage bridge proportional to the relative deviation of the measured resistance from the set

value goes to the input of a tolerance comparator where it is compared with set reference levels. The output signal goes to a decoder that controls a display. The system is made with integrated circuits, has an error of 0.02-0.1%, provides at least 60 dB suppression of signals with frequency in multiples of 50 Hz, has a measurement time of 0.06 s, range of measurable resistances of 1-10⁷ ohms, range of tolerance settings of +9.9%, and power dissipation of the measured resistor of no more than 0.006 W. References 3: 2 Russian, 1 Western.
[129-6610]

QUANTUM ELECTRONICS

UDC 535.317.1

INTERFERENCE IMMUNITY IN HOLOGRAPHIC INTERFEROMETRY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 11, Nov 80
pp 2342-2348 manuscript received 8 Jun 79

PANIBRATTSEV, Yu. A., SAFRONOV, G. S. and SAFRONOVA, A. P.

[Abstract] Holographic interferometry is an effective means of reconstructing the shapes of surfaces of remote objects. In practical applications, the accuracy of reconstruction depends on the errors of the method, and also on interference due to the direct action of emission from extraneous sources, and the reflections from the surface exposed to such sources. The structure of the interference patterns is also influenced by roughness of the surface to be reconstructed. In this paper the authors study the influence of these factors on holographic interferograms obtained from holograms produced by the two-source method. It is shown that interference in the form of white light with an intensity two orders of magnitude greater than that of the object beam will not cause appreciable deterioration of the visibility of holographic interferograms. In the case of monochromatic interference, the threshold of deterioration is at an order of magnitude above the intensity of the object beam. The interference immunity of holographic interferograms decreases with increasing roughness of the surfaces being photographed. Figures 4; references 5: 3 Russian, 2 Western.
[105-6610]

UDC 621.373.826.038.823

AMPLIFICATION OF SIGNALS IN THE 10.6 MICROMETER BAND IN WAVEGUIDE DISCHARGE TUBES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 23, No 11, Nov 80 pp 3-7 manuscript received 7 Jun 79, after revision 16 Oct 79

KUZYAKOV, B. A. and KHOR'KOV, V. F.

[Abstract] The performance of various discharge tubes for a waveguide-type continuous-duty CO_2 laser ($\lambda = 10.6 \mu\text{m}$) is analyzed in terms of signal amplification and power output. Theoretical calculations are based on the electron distribution and the electron concentration balance within the discharge region, taking into account ambipolar diffusion in the active medium. Under consideration are four different tubes: a cylindrical one made of molybdenum glass or alumina with two electrodes, a square one made of beryllia with two pairs of electrodes, a square one made of beryllia with two center anodes and a common cathode, and a similar one but made of metal with a high-reflectivity coating. The mean-volume gain was measured as a function of the pressure ($\text{Xe:N}_2:\text{CO}_2:\text{He} = 1:1:2:12$ mixture) at the pumping current density of 200 mA/cm^2 and the power output as a function of the pumping current density at the pressure optimum for each tube (56-94 torr). A comparative evaluation of the results, with the thermal

characteristics also taken into consideration, indicates the performance of the beryllia tube with two center anodes and a common cathode to be the best. A maximum power of 400 mW is attainable, measured near the emission threshold, with a pumping current density of 300 mA/cm^2 . Further improvement is possible with a circulating rather than stationary gas mixture. The reflection coefficient of the mirrors in the optical resonator should be higher than 0.89, moreover, for stable operation of such a waveguide-type CO_2 laser. Figures 4; references 8: 5 Russian, 3 Western (1 in translation).
[117-2415]

UDC 621.373.826.535.42

A STUDY OF THE SOUND DIFFRACTION OF HIGH POWER LASER RADIATION IN TeO_2

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1543-1545
manuscript received 3 Apr 79

PROKLOV, V. V., PESHIN, S. V., DAVYDOV, B. L. and SHKERDIN, G. N.

[Abstract] Samples of TeO_2 5x7x13 mm were exposed to giant pulses at a wavelength of 1.06 micrometers from a neodymium laser directed along the [001] axis. A slow acoustic wave propagated in the crystal along the [110] axis with shifts along the [110] axis. The power of the beam from the Q-switched laser falling on the crystal was measured with a calorimeter and amounted to a maximum of 0.3 J. For the pulse width of about 40 nanoseconds the corresponding light intensity on the crystal surface was about 250 MW/cm^2 . The TeO_2 was only subjected to single pulses, but even then fractures were observed in the output optical faces or in the volume of the sample, due to autofocusing of the light. At intensities of less than 1 MW/cm^2 the crystal sustained period laser beams at a repetition rate of 1 to 3 Hz. The diffracted light was detected with a photodiode. The diffraction efficiency is plotted as a function of the incident light power showing a gradual rise in the efficiency from 1.0% to 1.6% between 30 and 240 MW/cm^2 respectively. At a sound frequency of 145 MHz, the incident angle of the light on the crystal for maximum diffraction efficiency was about 9.2° while the total scattering angle was about 14.6° , a figure which is in satisfactory agreement with calculations based on anisotropic diffraction theory. The data obtained in this work, just as do the results of recently published literature for weaker acoustic-optical interaction, but at a higher sound frequency (up to 900 MHz), demonstrate the effect of the superlinear increase in the diffracted light intensity with an increase in the incident power by a factor of several times. This shows that the proposed use of stimulated processes for efficient control of high-power optical radiation with a low initiating acoustical power is quite a real prospect. The results of this work were presented at the 10th All-Union Conference on Quantum Acoustics and Acoustoelectronics, Tashkent, 1978. Figures 2; references: 4 Russian.
[317-8225]

WIDELY TUNABLE LASTING AT SUBMILLIMETER WAVELENGTHS USING PULSED CO₂ LASER
NONLINEAR FREQUENCY MIXING

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR: FIZIKA in Russian Vol 15, No 6, 1980 pp 455-457 manuscript received 6 Jun 80

AVETISYAN, Yu. O., BAGDASARYAN, D. A., POGOSYAN, P. S., SEMEROK, A. P. and SOBOLENKO, D. N., Yerevan State University

[Abstract] Laser pulses which are separated in frequency and synchronized in time were excited in the same TEA discharge volume by two optical resonators. The output end of the TEA chamber sent a pair of beams into a nonlinear GaAs crystal via two paths: One via a metal diffraction grating (100 lines/mm, blaze angle 30°) and a rotating mirror, and the other directly through a germanium plate. For a mixture of CO₂:N₂:He = 1:1:2, the radiation at the germanium plate output basically corresponds to the 00⁰1-10⁰0 transition of the CO₂; other components totaling less than 1%. The radiation energy at the output of the resonator formed by the TEA chamber and the germanium plate was 0.5 J and at the output of the system composed of the TEA chamber and the metal diffraction grating varied in a range of 0.05 to 0.5 J. Difference frequency lasing occurred in the high resistance (more than 10⁸ ohm·cm) GaAs crystal at a wavelength of 6 cm; the crystal was oriented so that the electrical field intensity vector of the exciting radiation was parallel to the [111] axis. The nonlinear interaction was synchronized by the appropriate choice of the angle between the interacting waves. The angle of propagation of the difference radiation proved to be greater than the total internal reflection angle, so to allow the radiation to exit the crystal, its end surface was cut at an angle of 22°. The difference frequency lasing is tunable in a range of 2 to 100 cm⁻¹. While no measurements were made of the absolute value of the radiation power in the submillimeter band, considering the fact that the conditions for difference frequency lasing are no worse than in the millimeter band, it is to be assumed that the power is on the order of 500 mW at a wavelength of 0.4 mm. It was noted that the difference frequency power changed markedly from burst to burst, reaching a maximum of about 30 mW when the power levels of the two frequencies being mixed were about the same and equal to 1 MW each. Spectral studies showed that the power instability at the difference frequency can be related to the redistribution of the overall power of the CO₂ laser among the adjacent lines: a disruption of the time synchronization of the pulses is also possible. Figures 1; references 4: 1 Russian, 3 Western.

[145-8225]

RADARS, RADIONAVIGATION AIDS,
DIRECTION FINDING, GYROS

UDC 621.396.96

USE OF THE INTERSCAN CORRELATION OF SIGNALS IN MOVING-TARGET SELECTION SYSTEMS

Kiev IZVESTIYA VYSSH. KH UCHEBNYKH ZAVEDENIY: RADIODELEKTRONIKA in Russian Vol 23, No 11, Nov 80 pp 74-75 manuscript received 13 Apr 79, after revision 12 Dec 79

YADRIKHINSKIY, A. Yu.

[Abstract] Digital systems for moving-target selection are considered where a special-purpose computer implements the algorithm of discrete Fourier transformation and where a memory module stores data over a scan cycle. Such a system effectively utilizes the interscan correlation of signals for processing of radar data. The necessary number of memory cells in each Doppler channel is determined by the number of resolution elements within a given space sector. Such a system will detect a target which has a zero radial velocity component, will suppress interference echo signal from moving noise sources with any space distribution, and does not require compensation of the "wind velocity", as long as the target moving at a velocity within the range characteristic of aircraft covers a noticeable distance during the period of one space scan. The performance of the proposed system is best evaluated by statistical simulation on a computer using a bivariate stationary random process with a Gaussian correlation function. Figures 2; references 4: 2 Russian, 2 Western.

[117-2415]

UDC 621.396.967.019.4

THE UTILIZATION OF A CURRENT ESTIMATE OF THE INVERSE CORRELATION MATRIX OF THE INTERFERENCE IN AN ADAPTIVE DETECTOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1540-1542 manuscript received 12 Sep 78

KOKIN, V. N., TEMEROV, A. V. and FEDININ, V. V.

[Abstract] One of the basic operations of multichannel radar reception algorithms is the multiplication of the row vector of the received signal by the inverse correlation matrix for the interference or for the mixture of the useful signal and the interference. In particular, with optimal detection of a quasideterminate signal with a degenerate correlation matrix, predetector processing reduces to the computation of a bilinear form of the output voltage of the linear section of the receiver. In the absence of a priori information, the received signals are the only source of data on the interference characteristics and by processing the received signal, a current estimate can be made of the interference correlation matrix. In order to obtain an optimal estimate in the general case, a filter having variable parameters should be the type used, the pulse response of which takes into account the a priori data on the nonsteady-state nature of the interference. This paper employs a simple model of the interference, considering it

to be steady-state over a certain time interval, and then computes the current estimate of the interference correlation matrix using a linear filter with constant parameters and a specified pulse characteristic which is a function of time, where the pulse width is less than the steady-state interval of the interference. Equations are written and solved for the optimization of such a detector and proposed configurations are shown, although no experimental data or sample calculations are cited in this purely theoretical treatment. Figures 3; references 4: 3 Russian, 1 Western.
[317-8225]

UDC 612.39b.9e9.3

THE STUDY OF THE RANGE OF DETECTION OF THE SEACOAST BY RADAR

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: GEOLOGIYA, GEOGRAFIYA in Russian
No 18 Issue 3, Sep 80 pp 98-105 manuscript received 15 Aug 79

KOTYUKH, A. A.

[Abstract] Statistical methods were used to develop equations expressing the variation of D as a function of h , where D is the maximum range of detection of the seacoast by shipborne navigational radar, and h is the height of the coast above sea level at the closest point. A total of 8,196 observations were made. A stereogram of the surface of the distribution of the range of detection of the seacoast is presented, as well as a correlation ellipse of D as a function of h . The range of detection is found to vary according to height of the coastline as a curved correlation function. A parabolic equation for D as a function of h is presented. Figures 2; tables 8; references: 3 Russian.
[141-6508]

SEMICONDUCTORS AND DIELECTRICS,
CRYSTALS IN GENERAL

UDC 533.7

THE PASSAGE OF 10 TO 25 KEV ELECTRONS THROUGH KBr DIELECTRIC FILMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1548-1550
manuscript received 28 Nov 77

KORNYUSHKIN, Yu. D. and SMIRNOV, B. N.

[Abstract] Dielectric films of KBr having a thickness of less than 15,000 Å were exposed to primary electrons with an energy ranging from 10 to 25 KeV; the electron beam was pulsed at a repetition rate of 0 - 100 Hz with a beam current density of about $2 \cdot 10^{-8}$ amp/cm². The pulse widths ranged from 10 to 20 microseconds. The integral reflection factor from the film and the yield efficiency were studied to compare the experimental results with the theoretical results of previous work by Kornyushkin [FIZIKA TVERDOGO TELA, 1978, No 20, p 1175]. The experimental values of the integral reflectivity expressed as a function of the film thickness are in good agreement with an empirical formula derived earlier for metals and semiconductors. Values of the parameters of the proposed expression for the transmittance where there is a slight divergence between the experimental and calculated values are shown and the reasons for the divergence are discussed. The use of a single velocity approximation of linear transport theory in order to describe electron passage through dielectric films is quite justified and rather precise (an error of 10% in the worst case). The utilization of a uniform normalized curve plotted from the proposed equation makes it possible to determine all the remaining characteristics of electron penetration into solid films from the initial characteristics. Figures 3; tables 2; references 8: 5 Russian, 3 Western.

[317-8225]

UDC 539.923:535

ABSORPTION OF 10.6 MICROMETER RADIATION BY HIGH-PURITY GERMANIUM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 7, Jul 80
pp 29-31 manuscript received 8 Oct 79

SISAKYAN, Ye. V., GINZBURG, M. I., GRISHIN, V. P. and MILENIN, E. S.

[Abstract] Single crystals of germanium are used as resonator components for continuous-duty CO₂ lasers on account of their excellent mechanical characteristics and high thermal conductivity, as well as their high refractive index at the 10.6 μm wavelength. Their thermal breakdown occurs at a temperature not much above 40°C, however, at which the absorption coefficient becomes a nonlinear function of the temperature. A study of this characteristic was made on three

groups of germanium specimens: 1) Pure p-type uncompensated ($n_A = n_D = 10^{13} \text{ cm}^{-3}$ at room temperature); 2) n-type slightly doped with antimony ($n_A = 10^{12} \text{ cm}^{-3}$); and 3) High-purity p-type ($n_A = n_D = 10^{11} \text{ cm}^{-3}$ and $n_A + n_D = (5-7) \cdot 10^{11} \text{ cm}^{-3}$ at 77 K). All were cut into plane-parallel disks (60 mm in diameter and 10 mm thick) with polished surfaces from single crystals grown by the Czochralski method, the last group after prior zone refining. The absorption coefficient, measured calorimetrically over a 10°C range of temperatures from room temperatures up, was found to be respectively 0.027 ± 0.003 , 0.018 ± 0.003 , and $0.022 \pm 0.001 \text{ cm}^{-1}$. The temperature of specimens had been raised uniformly by varying the power of the irradiating CO_2 laser from 10 to 100 W. Measured were also the electrical resistivity and the carrier mobility. The results indicate the feasibility of producing germanium with an absorption coefficient at $\lambda = 10.6 \mu\text{m}$ as low as 0.02 cm^{-1} . Tables 1: references 10: 2 Russian, 8 Western (1 in translation). [118-2415]

UDC 621.373.826:621.382.3

THE IMPACT OF THE PULSED RADIATION OF A RUBY LASER ON THE ELECTROPHYSICAL CHARACTERISTICS OF SILICON TRANSISTORS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1513-1521
manuscript received 1 Nov 79

POLYANINOV, A. V., PRUTSKOV, Ye. G., YANUSHKEVICH, V. A., KOLOMIYTSEV, I. M. and MILLER, Yu. G.

[Abstract] A Q-switched ruby laser was focused on silicon transistor samples glued to a quartz substrate. In order to study the effect of shock waves on the transistors, some of them were shielded from the direct exposure to the laser beam by a copper foil 55 micrometers thick. The substrate and the sample were immersed in a transparent oil bath with a high specific electrical resistance. About 11% of the beam energy was split off for measurement purposes and electrical signals derived from the instrumentation beam and the sample were fed to an oscilloscope. The results of using this set-up in order to study the effect of the radiation on KT319G transistors, which are widely used in hybrid IC's, were: 1) The light pulse of the ruby laser, as well as the shock waves it produced in an absorbing medium, with a pressure amplitude of up to 5 Kbar, are capable of boosting the collector current of the transistor by a factor of $10^4 - 10^5$. The return to equilibrium conductivity following both types of effects obeys an exponential law with the same time constant of 1.9 ± 0.2 microseconds. 2) The amplitude increment of the collector current with the passage of the shock waves increases exponentially with the rise in the pressure and exhibits a threshold nature. The threshold pressure at which the rise in the collector current is observed depends on the conditions under which the transistor is exposed, and ranges from 0.8 to 1.1 Kbar. 3) The rise in the collector current with the passage of the shock wave is related to the generation of nonequilibrium carriers in the space charge region of the collector junction. Additional studies are needed to determine the type of carriers which are produced. 4) After repeated exposure to laser pulses, a

rise in the inverse collector current by a factor of 2 to 4 is observed, which is the same as in the case of laser irradiation of a reverse biased p-n junction, and is apparently related to a change in the surface properties of the devices. Figures 7; references 15: 11 Russian, 4 Western (1 in translation).
[317-8225]

UDC 621.382.2.029.64

A THEORETICAL STUDY OF THE OPERATIONAL MODES OF GUNN DIODES WITH ENRICHED LAYERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1508-1512
manuscript received 14 May 79

PORESH, S. B.

[Abstract] Two mechanisms are found in the literature which account for the onset of oscillation of a Gunn diode in a limited charge accumulation mode: In the first, oscillation occurs with the suppression of the space charge due to the existence of a falling off segment of the volt-ampere characteristic of the device; the second states that oscillation occurs because of the accumulated charge in the space charge. The second case does not require monitoring of the rise in the space charge, but it is necessary to have an enriched layer. The limited charge accumulation mode is in fact similar to that which involves quenching of dipole domains and this paper terms the charge accumulation oscillator a space charge quenching oscillator. Analytical expressions are derived for the range of working frequencies of such Gunn diode space charge extinguishing oscillators, and are checked numerically using a local field model to account for the charge dynamics in the diode. An equivalent circuit of the oscillator is drawn showing a parallel RL network connected in series with the diode which is series connected with a battery. Graphs are plotted for the efficiency and power of such oscillators as a function of frequency for various doping concentrations. The distribution of the charge density and the electrical field intensity in the diode is also shown graphically for frequencies of 10 and 30 GHz. The parameters of the model circuit were: load resistance of 300 ohms; flat doping profile; cross-sectional area of 0.01 mm^2 . A maximum oscillator frequency of 28 GHz is noted. The behavior of the upper and lower cutoff frequencies are discussed as a function of the dopant concentration, and the maximum frequency is plotted as a function of impurity concentration. The author thanks A. S. Tager for attention to the work. Figures 4; references 5: 3 Russian, 2 Western.
[317-8225]

ON THE PROCESS OF SWITCHING INVERSE CONDUCTANCE MODULATOR THYRISTORS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 25, No 7, Jul 80 pp 1560-1562
manuscript received 12 Mar 79

SHUMAN, V. B.

[Abstract] Modulator thyristors with inverse conductance have a faster rise time than conventional four-layer modulator thyristors. According to the model proposed by the author of the transport mechanisms in such devices, the following should be experimentally observed: 1) The delay time in the onset of the regenerative process should be independent of the thickness and degree of doping of layer 4 of the wide base (the structure is pictures as $n^+-p-n-n^+-p^+$, designated layers 1 - 5, respectively, with the terminals attached to layers 1, 2 and 5); and 2) The influence of avalanche injection on the curve of the regenerative process should weaken with a decrease in the doping level of layer 4, since the arrival of holes from the p-emitter attenuates the effect produced by the electron current and will interfere with the formation of the shock ionization region at the boundary of layers 3 and 4. This short communication is an experimental test of these hypotheses and a description of the fabrication technology of the proposed device. It was found that the delay time in the onset of the regenerative process rose markedly with an increase in the degree of doping of layer 4, and increasing the thickness of this layer also increased this time, other conditions being equal. The experimental check of the second hypothesis was also negative, since the regenerative stage exhibits a current rise which is exponential for the semiconductor structures treated here. The proposition that avalanche injection influences the transient switching process in inverse conductance thyristors, proposed by A. F. Kardo-Sysoyev, et al. [RADIOTEKHNIKA I ELEKTRONIKA, 1975, No 8, p 1768], is thus experimentally refuted. The author thanks V. P. Reshetin for assistance in conducting the experiments. Figures 2: references: 3 Russian.

{317-8225}

VARIOUS MISCELLANEOUS ITEMS,
INCLUDING THEORIES

UDC 53.085.32:772.1

PREPARATION OF OPTICAL GRIDS AND SCALES BY 'REVERSE' PHOTOLITHOGRAPHY

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 6, Jun 80
pp 26-27 manuscript received 8 Oct 79

FLEYSHER, A. I. and NAUMOVA, S. F.

[Abstract] "Reverse" photolithography is used increasingly throughout the world for preparation of optical grids and scales with photoresist masks. High optical precision of scales on dull grid surfaces, a problem in direct photolithography, has been found attainable by the "reverse" method. The process consists of five steps: deposition of photoresist and drying, exposure through a template, development, metallization, elution of photoresist and cleaning. In an experimental study with the FP-383 positive photoresist, this method was found to eliminate the need for etching and tanning, to yield satisfactory results with chemically less stable photoresists, and to make feasible producing a direct negative by contactive copying. Figures 1; references: 3 Russian.
[119-2415]

UDC 535.315

DESIGN OF OPTICAL FRESNEL MIRRORS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 6, Jun 80
pp 17-20 manuscript received 9 Aug 78

VIFANSKIY, Yu. K.

[Abstract] A method of designing optical Fresnel mirrors is shown which yields the required optical characteristics at any position of the source, as well as that of its image, relative to such a mirror. The design parameters calculated accordingly are the inclination angle of active faces relative to the carrier surface, the inclination angle of passive lateral faces, which determines the chamber of the cutting tool, and also the depth of concentric grooves in the mirror. These calculations have been programmed for a computer. Figures 4; tables 1.
[119-2415]

OPTICAL CHARACTERISTICS OF INTERFERENCE-TYPE NOTCH FILTERS MADE OF LEAD TELLURIDE AND BARIUM FLUORINE LAYERS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 6, Jun 80 pp 8-10
manuscript received 7 Jul 79

GISIN, M. A., MUSTAYEV, R. M. and UCHAYKIN, A. G.

[Abstract] Stoichiometric lead telluride (60% Pb) films, best produced by discrete vacuum evaporation of fine-grain lead-tellurium powder in a molybdenum crucible at 830-870°C and deposited on a substrate at 160-180°C, have a refractive index $n \sim 5$ and a low absorption coefficient $k \sim 70 \text{ cm}^{-1}$ constant over the $\lambda = 5-12 \mu\text{m}$ transparency window in the infrared region of the spectrum. A study was made of interference-type infrared notch filters for suppressing short-wave radiation up to certain wavelengths and passing radiation of longer wavelengths. These filters were multilayer stacks of alternate lead telluride films ($n = 5$) and barium fluoride films ($n = 1.4$) on a barium fluoride substrate ($n = 1.4$). Measurements of the spectral characteristics, namely the transmission spectra, of experimental 7-, 9-, and 11-layer stacks of respectively 0.85, 1.05, and $1.3 \mu\text{m}$ total thickness indicate an appreciable contribution of lead telluride to widening the filtration range, especially where its intrinsic absorption band coincides with a secondary short-wave band. A practical filter consisting of a main 9-layer stack and a supplementary 7-layer stack was built with a cutoff wavelength $\lambda = 10 \mu\text{m}$ and a transmission coefficient $T \leq 10^{-4}$ in the short-wave range, except $f \leq 6 \cdot 10^{-4}$ in the $\lambda = 4-5 \mu\text{m}$ band. A filter for this cutoff wavelength with the PbTe-BaF₂ combination requires one third of the number of layers required with the Sb₂S₃-SrF₂ combination, half as many layers as required with the Ge-SrF₂ combination, and two thirds of the number of layers required with the PbTe-ZnS combination. Such a filter can withstand 98% relative humidity at 40°C for 15 days and 6 slow temperature cycles from 60 to -60°C at a rate not exceeding 2°C/min with 1 h holding time at certain temperatures. Figures 3; tables 1; references 9: 5 Russian, 4 Western (1 in translation).

[119-2415]

UDC 538.23:538.521.1.001.2

MAGNETIZATION REVERSAL IN A FERROMAGNETIC PLATE IN A UNIFORM MAGNETIC FIELD
VARYING NONSINUSOIDALLY WITH TIME

Moscow IZVESTIYA AKADEMII NAUK SSSR: ENERGETIKA I TRANSPORT in Russian No 5,
Sep-Oct 80 pp 69-84 manuscript received 15 Mar 79

ABRAMKIN, Yu. V. and IVANOV-SMOLENSKIY, A. V., Moscow

[Abstract] Magnetization reversal in a ferromagnetic plate in a nonperiodically varying nonharmonic magnetic field is considered, this plate being infinitely large with a finite thickness and made of a square-loop material. Eddy currents in this plate do not affect the magnetic field intensity at the surface. Two systems of differential equations describing the distributions of magnetic and electric field intensities at any instant of time are derived directly from the appropriate Maxwell field equations: one for the inner plate region and one for its peripheral regions, the boundary between them defined by the location of the induction wave front at time $t=0$. These equations are solved, taking into account the velocity of the induction wave front and assuming a plate sufficiently thick so that losses due to magnetization reversal occur, after the transient period, within less than the entire plate volume. The power loss is also calculated according to the Poynting vector, using the Kirchhoff network laws and Fourier series. Figures 5; references 13: 11 Russian, 2 Western.

[124-2415]

UDC 681.7.068.4

CHANGES IN THE SURFACE OF FIBER-OPTIC PLATES DUE TO HEAT TREATMENT

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 6, Jun 80
pp 31-33 manuscript received 17 Jul 79

BUZHINSKIY, I. M., NIKISHCHENKO, Ye. A. and KRAVTSOVA, N. I.

[Abstract] Fiber-optic plates are produced with a very fine surface finish $S_2^{0.50\sqrt{0.8}}$, deviations from planarity and sphericity not exceeding $(4-10)\cdot 10^{-2}$ interference fringes. During subsequent assembly with other components they are often subjected to heat treatment at $450-520^\circ\text{C}$, the softening temperature of glasses for these plates falling within this range. A study was made to determine the effect of such a heat treatment on plane and spherical fiber-optic plates, using combinations of TBF10/VT046 and VS58/VT042 of glass grades with the coefficients of linear thermal expansion $(72+2)\cdot 10^{-7}$ and $(52+2)\cdot 10^{-7}$ $(^\circ\text{C})^{-1}$ over the $20-300^\circ\text{C}$ range. The results indicate that such a heat treatment is dangerous, especially for large surfaces, and other surface treatment afterwards is required. Figures 3; tables 1; references 3: 2 Russian, 1 Western in translation.

[119-2415]

CSO: 1860

- END -

END OF

FICHE

DATE FILMED

23 April 1981